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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 24, NUMBER 12
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W91-11601 -- W91-12939

The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of the Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1992.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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04 WATER QUANTITY MANAGEMENT AND CONTROL

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05 WATER QUALITY MANAGEMENT AND PROTECTION

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Institute of Hydrology, Wallingford (England).
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Moncton Univ. (New Brunswick). School of Engineering.
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Alaska Univ., Fairbanks. Water Research Center.
For primary bibliographic entry see Field 2C.
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For primary bibliographic entry see Field 2E.
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Agricultural Coll. of Athens (Greece).
For primary bibliographic entry see Field 2G.
W91-12317

HYDROLOGIC CHARACTERISTICS AND WATER BALANCE OF AN ALPINE BASIN IN THE SIERRA NEVADA.
California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
R. Kattelmann, and K. Elder.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1553-1562, July 1991. 3 fig, 8 tab, 54 ref.
California Air Resources Board Contract Nos. A3-106-32 and A6-147-32.

Descriptors: *California, *Emerald Lake Watershed, *Hydrologic budget, *Hydrologic properties, *Mountain watersheds, Alpine regions, Evaporation, Evapotranspiration, Groundwater budget, Precipitation, Seasonal variation, Sierra Nevada, Snow, Snowmelt, Streamflow, Water depth.

A water balance prepared for the Emerald Lake basin illustrates the absolute and relative magnitudes of the main water transfers in this alpine catchment in the Sierra Nevada over two water years. The water balance over both years, expressed as equivalent water depths averaged over the catchment area, was total precipitation (3670 mm)-total losses in the atmosphere (800 mm)=total streamflow (2830 mm)+residual (40mm). Snow dominated the water balance during the study period, accounting for 95% of the precipitation. The spring snowmelt periods accounted for > 85% of the annual streamflow and were followed by long recessions through summer, autumn, and winter. Estimated total evaporation from snow, water surfaces, soil, and vegetation at Emerald Lake was 22% of the estimated precipitation. Evaporation from snow was the principal water loss to the atmosphere, accounting for about 80% of the total evaporation. Actual evapotranspiration estimated over 15 non-winter months was < 4% of the precipitation during the two water years. Groundwater storage and release accounted for only a small portion of the total quantity of water in the annual water balance of this largely impermeable basin. (See W91-12329) (Author's abstract)
W91-12331

DAILY HYDROCLIMATOLOGICAL DATA SET FOR THE CONTINENTAL UNITED STATES.
IBM Thomas J. Watson Research Center, Yorktown Heights, NY.
J. R. Wallis, D. P. Lettenmaier, and E. F. Wood.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1657-1663, July 1991. 3 fig, 1 tab, 15 ref.
Pacific Northwest Laboratory Contract DE-AC06-76RLO 1930 and USGS Grant 14-08-0001-G1753.

Descriptors: *Climatology, *Hydroclimatology, *Hydrologic data collections, *Model studies, *Networks, *United States, Data acquisition, Data collections, Hydrometeorology, Precipitation, Streamflow, Temperature.

A daily hydrometeorological data set for the continental United States was constructed for use in climate studies. The data were taken from USGS daily streamflow data and NOAA daily climatological data for precipitation and maximum and minimum temperature. Care was taken to assure that the streamflow records were essentially free from regulation. The climatological stations were a subset of the historical climatology network (HCN) stations for which monthly data were described. Missing data were estimated using observations from nearby gauges and long-term monthly means. Approximately 5% of the days were missing in the records and had to be estimated. The daily meteorological data were further adjusted to be consistent at the monthly level with the HCN data. It is believed that these data are relatively free from anthropogenic effects and should be suitable for studying a wide range of hydroclimatological problems where daily data are necessary. However, users should be aware that errors do exist, especially in the climatological data, and should exercise due caution. (Lantz-PTT)
W91-12340

INVESTIGATION OF CURVE NUMBER PROCEDURE.
Agricultural Research Service, Columbia, MO.
For primary bibliographic entry see Field 2B.
W91-12358

PROGRESS AND OPPORTUNITIES IN HYDROLOGIC RESEARCH, 1987-1990.
Agricultural Research Service, Riverside, CA. Salinity Lab.
M. T. Van Genuchten.
Reviews of Geophysics RVGPB4, Vol. Supp, p 189-192, 1991. 14 ref.

Descriptors: *Geohydrology, *Hydrologic research, *Hydrology, *Research priorities, Catchment areas, Groundwater movement, Heterogeneity, Hydrologic systems, Ice, Path of pollutants, Porous media, Snow, Solute transport, Surface water.

The U.S. National Report for Hydrology to the International Union (IUGG) for the quadrennium 1987-1990 consists of nine papers covering various aspects of the hydrological sciences, including global-scale hydrology, catchment hydrology, surface water modeling, snow and ice research, and subsurface water flow and contaminant transport. The papers reveal many opportunities for innovative research in the hydrologic sciences. These opportunities are predicated, among other things, by the introduction of new methods for modeling and measuring water and contaminant processes in naturally heterogeneous soil and groundwater systems, and by increased emphasis on global-scale processes motivated in part by concerns about global climate change. For convenience, the papers are divided into two broad categories: surface hydrology and subsurface hydrology. The surface hydrology papers discuss: global-scale hydrology; surface water modeling; and snow and ice research. The subsurface hydrology papers are on : flow and transport processes in the unsaturated zone; contaminant transport in the saturated zone; flow and transport in fractured rock; transport in heterogeneous media from a more general perspective; and, physical measurements in subsurface hydrology. (Lantz-PTT)
W91-12503

GLOBAL SCALE HYDROLOGY: ADVANCES IN LAND SURFACE MODELING.
Princeton Univ., NJ. Water Resources Program.
E. F. Wood.
Reviews of Geophysics RVGPB4, Vol. Supp, p 193-201, 1991. 6 fig, 1 tab, 76 ref.

Descriptors: *Global precipitation, *Hydrology, *Literature review, *Model studies, General circulation models, Hydrologic properties, Land classification, Precipitation.

Research into global scale hydrology is an expanding area that includes researchers from the meteorology, climatology, ecology and hydrology communities. This paper reviews literature in this area carried out in the United States during the last International Union of Geodesy and Geophysics quadrennial period of 1987-1990. The review covers the representation of land surface hydrologic processes for general circulation models (GCMs), sensitivity analysis of these representations on global hydrologic fields like precipitation, regional studies of climate that have global hydrologic implications, recent field studies and experiments whose aims are the improved understanding of the spatial variability of surface hydrologic processes that are important at regional and global climate scales. (Author's abstract)
W91-12504

CATCHMENT HYDROLOGY.

Field 2—WATER CYCLE

Group 2A—General

Agricultural Research Service, Tucson, AZ. Arid-land Watershed Management Research Unit.
D. C. Goodrich, and D. A. Woolhiser.
Reviews of Geophysics RVGPB4, Vol. Supp, p 202-209, 1991. 115 ref.

Descriptors: *Catchment areas, *Hydrologic budget, *Literature review, *Model studies, *Rainfall-runoff relationships, *Surface-groundwater relations, Hydrologic properties, Hydrological regime.

Although important progress has been made in catchment hydrology research, a detailed, process based, understanding of hydrologic response over a range of catchment scales (0.01-500 sq km) still eludes the hydrologic community. Selected research efforts, primarily from refereed journals, conducted by U.S. (or U.S. based) investigators for the period of late 1986 to 1990 are reviewed. The literature reviewed is restricted to an examination of entire catchment response rather than that of a single process component such as routing or infiltration. Therefore, point or plot scale studies, modeling of a single process or analyses more strictly focused on erosion and water quality issues are not addressed unless they provide insights into catchment hydrologic behavior. Research addressed that does not fit neatly into these criteria includes automation of catchment modeling efforts, as well as aspects of similarity and scale in catchment hydrology. (Lantz-PTT)
W91-12505

PROGRESS IN SURFACE WATER MODELING.
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-12506

PRINCIPLES OF MODELLING.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-12569

PALEOLIMNOLOGY AND HINDCASTING CLIMATIC TRENDS.
Queen's Univ., Kingston (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-12772

2B. Precipitation

EFFECTS OF SPATIALLY-DISTRIBUTED RAINFALL ON RUNOFF FOR A CONCEPTUAL CATCHMENT.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W91-11657

RAINFALL NETWORK DESIGN THROUGH COMPARATIVE KRIGING METHODS.
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W91-11793

REGIONAL CLIMATE CHANGE IMPACTS: I. IMPACTS ON WATER RESOURCES.
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W91-11795

SHORT-TERM TRENDS AND SPATIAL VARIABILITY IN PRECIPITATION CHEMISTRY IN THE SOUTH COAST AIR BASIN.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W91-11829

SHORT TERM FORECASTING OF CLOUD AND PRECIPITATION.
Air Force Geophysics Lab., Hanscom AFB, MA.
A. Bohne, F. I. Harris, P. A. Sadoski, and D. Egerton.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A212 692. Price codes: A06 in paper copy, A01 in microfiche. Report Number AFGL-TR-88-0032; ERP, No. 994. 104 p, 30 fig, 10 tab, 15 ref, append.

Descriptors: *Clouds, *Computer models, *Meteorology, *Precipitation forecasting, *Weather forecasting, Computer programs, Meteorological data, Meteorological data collection, Radar, Weather patterns.

A methodology for real-time operations has been developed for the short-term forecasting of cloud and precipitation fields. Pattern recognition techniques are employed to extract useful features from the data field and extrapolation techniques are used to project these features into the future. To reduce computational load, contours defined by directional codes are used to delineate features. These contours are subdivided and attributes such as length, location, and location of each segment are determined. Segment matching is performed for successive observations and attribute changes are monitored over time. Several techniques for the forecasting of attributes have been explored, and an exponential smoothing filter and a linear trend adaptive smoothing filter were chosen as most appropriate. Currently, analysis is performed on a minicomputer and image processor system utilizing radar reflectivity data. Refinement of these techniques and extension into a more comprehensive short term forecasting program is planned. (Author's abstract)
W91-11830

LARGE-SCALE OCEAN ATMOSPHERIC VARIABILITY ASSOCIATED WITH HYDROLOGICAL EXTREMES IN WESTERN NORTH AMERICA.
Scripps Institution of Oceanography, La Jolla, CA. Climate Research Group.
D. R. Cayan, J. O. Roads, and J. Namias.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-159400. Price codes: A08 in paper copy, A01 in microfiche. Final Report, June, 1990. 8p, 6 append. USGS Contract No. 14-08-0001-G1483.

Descriptors: *Atmospheric circulation, *Climatology, *North America, *Precipitation, *Streamflow, Drought, Great Salt Lake, Oceans, Precipitation forecasting, Storms.

Research in this project centered around the effects of Northern Hemisphere atmospheric circulation on precipitation and streamflow in North America from monthly to several year time scales, and a diagnosis of numerical predictions of precipitation from the U.S. National Meteorological Center's medium and extended range model on weekly and monthly time scales. Monthly and seasonal northern hemisphere atmospheric flow patterns provided insight in diagnosing the great continental drought over the United States during Summer 1988, effects of atmospheric anomalies on the record-breaking rise in the Great Salt Lake in 1981-1986, the effect of Pacific Ocean surface conditions and atmospheric circulation on streamflow variability and stream chemistry in western North America, and the identification of extreme southerly displaced North Pacific storms which cause flooding in the San Bernadino Mountains and the Mojave River watershed. To evaluate extended range precipitation forecasts (2-10 days lead), an extensive comparison of medium and extended range National Meteorological Center Model forecasts was made with observations. This work culminated in the publication of five journal articles listed in the bibliography of the final report to this contract. (USGS)
W91-11871

SELECTED METEOROLOGICAL DATA FOR AN ARID CLIMATE OVER BARE SOIL NEAR BEATTY, NYE COUNTY, NEVADA, NOVEMBER 1977 THROUGH MAY 1980.
Geological Survey, Charleston, WV. Water Resources Div.
R. G. Brown, and W. D. Nichols.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-195, 1990. 48p, 15 fig, 1 tab, 1 ref.

Descriptors: *Arid climates, *Bare soil, *Meteorological data, *Precipitation, Air temperature, Beatty, Net radiation, Nevada, Nye County, Soil heat flux, Soil temperature, Solar radiation, Wind direction, Wind speed.

Meteorological data were collected over bare soil at a site for low-level radioactive waste burial near Beatty, Nevada, from November 1977 to May 1980. The data include precipitation, windspeed, wind direction, incident solar radiation, reflected solar radiation, net radiation, dry-bulb and wet-bulb air temperatures at three heights, soil temperature at five depths, and soil-heat flux at three depths. Mean relative humidity was computed, for each day of the collection period for which data are available. A discussion is presented of the study site and the instrumentation and procedures used for collecting and processing the data. Diurnal fluctuations of selected meteorological variables for representative summer and winter periods are presented. The effects on selected variables of a partial solar eclipse are also discussed. (USGS)
W91-11940

PHYSICAL FACTORS INFLUENCING WINTER PRECIPITATION CHEMISTRY.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Atmospheric Physics Lab.
J. L. Collett, A. S. H. Prevot, J. Staehelin, and A. Waldvogel.
Environmental Science and Technology ESTHAG, Vol. 25, No. 4, p 782-788, April 1991. 7 fig, 28 ref.

Descriptors: *Acid rain, *Atmospheric physics, *Chemistry of precipitation, *Meteorology, *Rime, *Snow, Aerosols, Air masses, Air pollution effects, Cloud chemistry, Cloud liquid water, Path of pollutants, Seasonal variation, Water transport, Weather patterns.

Two case studies of winter precipitation events highlight the roles of transport and snow crystal riming (the capture of supercooled cloud droplets by snow crystals) in determining precipitation chemistry. In one case, passage of a cold front leads to a change in the air mass producing precipitation over the monitoring site. A simultaneous decrease in precipitation ion concentration is observed. Correlations of the ion concentrations with the pseudoequivalent potential temperature, which serves as an air mass identifier, suggest that the decrease in ion concentrations is caused by the air mass change, rather than by washout of aerosols and gases from the atmosphere. In the second case, evidence is presented indicating that an increase in precipitation ion concentrations results from significant capture of polluted cloud water droplets by the snow crystals. In order to study other processes influencing precipitation chemistry that occur on similar time scales, it is important to evaluate possible confounding effects of transport and riming. (Author's abstract)
W91-11968

LOW-INTENSITY RADIOLYSIS STUDY OF FREE-RADICAL REACTIONS IN CLOUDWATER: H2O2 PRODUCTION AND DESTRUCTION.
Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
J. Weinstein-Lloyd, and S. E. Schwartz.
Environmental Science and Technology ESTHAG, Vol. 25, No. 4, p 791-800, April 1991. 9 fig, 2 tab, 47 ref. NSF grants ATM-8808480 and ATM-8911296 and DOE contract DE-AC02-76CH00016.

Descriptors: *Acid rain, *Atmospheric chemistry, *Cloud chemistry, *Cloud liquid water, *Free radicals, *Hydrogen peroxide, Iron, Model studies,

Radioactivity techniques, Sulfur dioxide, Sulfuric acid.

The yield of H2O2 (hydrogen peroxide) in synthetic and authentic cloudwater solutions has been examined under low-intensity continuous radiolysis at radical generation rates comparable to those expected to result in the ambient sunlit atmosphere from transfer of HO2 (hydroperoxyl) free radicals from gas phase to cloudwater. H2O2 is produced in synthetic solutions containing H(+) (hydrogen), SO4(2-) (sulfate), NO3(-) (nitrate), and NH4(+) (ammonium) ions, and H2CO (formaldehyde) and H2O2 at rates consistent with expectations based on complete conversion of O2(-I) (superoxide) to H2O2. However, H2O2 yields in authentic cloudwater are substantially lower, indicative of alternative free-radical sinks and/or reaction of the H2O2 produced. In synthetic solutions containing S(IV) (dissolved sulfur dioxide), the decrease in H2O2 yield is due largely to the molecular H2O2-S(IV) reaction; however, significant reaction of O2(-I) with S(IV) is indicated. Addition of iron decreases the H2O2 yield, principally because of the destruction of H2O2 by reaction with Fe(II) (ferrous ion). Model calculations incorporating these reactions under representative atmospheric conditions establish that overall H2O2 yields can be enhanced or decreased by reactions in cloudwater depending on the concentrations of aqueous Fe and H2O2. (Feder-PTT)
W91-11969

STEM-II ACID DEPOSITION AND PHOTOCHEMICAL OXIDANT MODEL: II. A DIAGNOSTIC ANALYSIS OF MESOSCALE ACID DEPOSITION.
Iowa Univ., Iowa City. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5B.
W91-11988

LAGRANGIAN BACKWARD TRAJECTORY MODEL AND ITS APPLICATION TO THE STUDY OF ACID RAIN IN THE EMEI MOUNTAINOUS DISTRICT.
Tongji Univ., Shanghai (China). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5B.
W91-11989

OUTPUT RELIABILITY AS GUIDE FOR SELECTION OF RAINFALL-RUNOFF MODELS.
Rutgers - The State Univ., Piscataway, NJ. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W91-12208

PRECIPITATION DEVELOPMENT IN SOME CUMULUS CONGESTUS AS A FUNCTION OF THE ENVIRONMENTAL CONDITIONS IN CCOPE.
Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Ciencias de la Atmosfera.
C. Latorre D.
Atmosfera ATMSEF, Vol. 4, No. 2, p 79-86, April 1991. 3 fig, 1 tab, 8 ref.

Descriptors: *Cloud liquid water, *Clouds, *Meteorology, *Precipitation, Atmospheric physics, Atmospheric water, Cloud physics, Precipitation efficiency, Radar, Static head, Weather, Wind shear.

Radar and direct aircraft measurements were used to characterize the precipitation development up to the mature stage at the high levels of some long-lived cumulus congestus and to estimate the precipitation efficiency at their cloud base. The observations at about the -12 C level were studied as a function of the overall particle growth environment and of the atmospheric conditions. The results indicated that the concentrations of ice particles or alternatively the maximum attained reflectivity were sensitive functions of the cloud lifetime and correlated positively with the atmospheric static energy. The concentration of precipitation in the higher layers of the clouds for days with moderate to marginal instability could be related to the positive energy of the environment. Precipitation efficiency was estimated from 0 to 30% for these clouds. No clear relationship was found between the precipitation efficiency and the vertical wind shear. These results contrast with previous well known findings for large storms that showed the clouds studied had no apparent influence from the vertical wind structure. The 13 clouds used as the base of this study were too few to attain significant statistical results. However, the analysis relied more on the quality of data produced by independent sources. (Mertz-PTT)
W91-12250

SO2 OXIDATION IN A RAINBAND: EFFECTS OF IN-CLOUD H2O2 PRODUCTION.
McGill Univ., Montreal (Quebec). Dept. of Meteorology.
For primary bibliographic entry see Field 5B.
W91-12252

GLOBAL PRECIPITATION ESTIMATES FROM SATELLITE: USING DIFFERENCE FIELDS OF OUTGOING LONG-WAVE RADIATION.
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
M. L. C. Wu.
Atmosphere - Ocean ATOCDA, Vol. 29, No. 1, p 150-174, March 1991. 12 fig, 22 ref.

Descriptors: *Meteorology, *Precipitation mapping, *Remote sensing, *Satellite technology, Data collections, Difference fields, Infrared radiation, Precipitation, Radiation, Rainfall index, Weather data collections.

Global precipitation estimates using satellite data were derived using difference fields of outgoing long-wave radiation. The difference fields consisted of clear outgoing long-wave radiation minus cloudy outgoing long-wave radiation, which is a measure of long-wave cloud radiative forcing at the top of the earth-atmosphere system; and clear daytime outgoing long-wave radiation minus clear night-time outgoing long-wave radiation, which is a measure of the diurnal variation of surface heating. All geophysical parameters used to compute the outgoing long-wave radiation were derived from an analysis of the sounding data. The derived global precipitation estimates showed good agreement with collected raingage data over land. The correlation coefficient between the precipitation estimates derived using difference fields of outgoing long-wave radiation and raingage data over land was about 0.65. The correlation coefficient between precipitation estimates derived using difference fields of outgoing long-range radiation GOES Precipitation Index fraction was about 0.914 from 30 degrees south to 30 degrees north for July 1983, and between the precipitation estimates derived using difference fields of outgoing long-wave radiation and the difference field of atmospheric reflectance was about 0.86. Using one set of coefficients, global precipitation fields were derived for each 10-day period and each month from December 1978 to November 1979. These fields contained rich information on seasonal variations. (Author's abstract)
W91-12253

EVALUATION OF RAINDROP SPECTRA. PART I: SOLUTION TO THE STOCHASTIC COLLECTION/BREAKUP EQUATION USING THE METHOD OF MOMENTS.
Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
For primary bibliographic entry see Field 7C.
W91-12304

FURTHER DEVELOPMENTS OF THE NEYMAN-SCOTT CLUSTERED POINT PROCESS FOR MODELING RAINFALL.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
P. S. P. Cowpertwait.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1431-1438, July 1991. 5 fig, 2 tab, 15 ref, append.

Descriptors: *Mathematical models, *Meteorology, *Model studies, *Neyman-Scott Clustered Point Process, *Rainfall, *Statistics, *Stochastic process, Blackpool, Case studies, Data interpretation, England, Precipitation, Rain, Simulation analysis.

This paper provides some useful results for modeling rainfall, and extends work on the Neyman-Scott cluster model for simulating rainfall time series. Several important properties have previously been found for the model, including the expectation and variance of the amount of rain captured in an arbitrary time interval. Additional properties are derived in this study, such as the probability of an arbitrary interval of any chosen length being dry. In applications, this is a desirable property to have, and is often used for fitting stochastic rainfall models to field data. The model is currently being used in rainfall time series research directed toward improving sewage systems in the United Kingdom. To illustrate the model's performance an example is given, where the model is fitted to 10 years of hourly data taken from Blackpool, England. (Author's abstract)
W91-12320

SNOW ACCUMULATION AND DISTRIBUTION IN AN ALPINE WATERSHED.
California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
For primary bibliographic entry see Field 2C.
W91-12330

PRECIPITATION CHEMISTRY IN AND IONIC LOADING TO AN ALPINE BASIN, SIERRA NEVADA.
California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
M. W. Williams, and J. M. Melack.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1563-1574, July 1991. 4 fig, 10 tab, 51 ref. California Air Resources Board Contract Nos. A3-103-32 and A6-147-32.

Descriptors: *Acid rain, *California, *Chemistry of precipitation, *Emerald Lake, *Ions, *Mountain watersheds, *Path of pollutants, *Sierra Nevada, Acetic acid, Aerosols, Air pollution, Alpine regions, Ammonium, Environmental chemistry, Formic acid, Hydrogen ion concentration, Nitrates, Rainfall, Runoff, Seasonal variation, Snow, Snowmelt, Sulfates.

Wet deposition of solutes to an alpine catchment in the southern Sierra Nevada was measured from October 1984 through March 1988. Rainfall had a volume-weighted pH of 4.9, and snowfall had a volume-weighted pH of 5.3. Acetic and formic acids were important components of all wet deposition, contributing 25-30% of the measured anions in snowfall and, through analysis of charge balance deficits, the same percentage in rainfall. The NO3(-) to SO4(2-) equivalent ratio for all wet deposition was 1.16. Ammonium concentration was tenfold greater than H(+) in rainfall; ammonium nitrate and ammonium sulfate appear to be the principal nitrate and sulfate containing aerosols in wet deposition. Snowmelt runoff (1985 and 1986) or snowpack runoff plus rainfall during the period of snowpack runoff (1987) supplied 90% of the annual solute flux from wet deposition to the catchment. The amount of snow water equivalence (mm/sq m) and H(+), SO4(2-), and Cl(-) (eq/sq m) in cumulative snowfall measured on snowboards was similar to the accumulated deposition of these parameters measured in snowpits at midwinter and during maximum snow accumulation periods, while about 20% of NO3(-) in snowfall was not stored in the winter snowpack. Dry deposition was therefore not an important contributor of H(+), NO3(-), and SO4(2-) to the winter snowpack. The source of the ions in snowfall was air masses that originated over the Pacific Ocean, while low Cl(-) and Na(+) relative to NO3(-) and NH4(+) in rainfall indicate that local urban and agricultural areas were the major source of the ions in rainfall. (See W91-12329) (Author's abstract)
W91-12332

DAILY HYDROCLIMATOLOGICAL DATA SET FOR THE CONTINENTAL UNITED STATES.
IBM Thomas J. Watson Research Center, Yorktown Heights, NY.
For primary bibliographic entry see Field 2A.
W91-12340

INVESTIGATION OF CURVE NUMBER PROCEDURE.
Agricultural Research Service, Columbia, MO.
A. T. Hjelmfelt.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 6, p 725-737, June 1991. 5 fig, 1 tab, 46 ref, append.

Descriptors: *Agricultural watersheds, *Rainfall distribution, *Rainfall-runoff relationships, *Runoff volume, Hydrographs, Model studies, Precipitation, Storms.

The curve number procedure of the Soil Conservation Service is a method that might best be used to transform a rainfall frequency distribution to a runoff frequency distribution. It was originally intended for runoff volume and for developing design hydrographs for small agricultural watersheds. Its ease of application and lack of serious competition resulted in a dramatic expansion of its scope of application. Despite its wide use, however, documentation of its origin is severely limited. The curve number is not a constant, but varies from event to event. This variability can be summarized by treating the potential maximum retention as a random variable. The antecedent moisture condition (AMC) II value represents the central tendency and AMC I and III represent extremes. The variability of the curve number leads to difficulty in attempting to determine curve numbers using events n which runoff is a small fraction of the rainfall. This is caused by the rainfall events that result in no runoff. A curve number should be associated with each of these, but cannot. Antecedent precipitation explains only a portion of the curve number variability. Wet antecedent conditions are associated with high curve numbers (S), while dry antecedent conditions are associated with a wide spectrum of curve numbers. Apparently, other watershed and storm characteristics become important when evaluating these dry conditions. (Doria-PTT)
W91-12358

AIRCRAFT MULTIFREQUENCY PASSIVE MICROWAVE OBSERVATIONS OF LIGHT PRECIPITATION OVER THE OCEAN.
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
For primary bibliographic entry see Field 7B.
W91-12387

RAINFALL PARAMETER ESTIMATION FROM DUAL-RADAR MEASUREMENTS COMBINING REFLECTIVITY PROFILE AND PATH-INTEGRATED ATTENUATION.
Communications Research Lab., Tokyo (Japan).
T. Kozu, and K. Nakamura.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 8, No. 2, p 259-270, April 1991. 12 fig, 4 tab, 22 ref.

Descriptors: *Radar, *Rainfall, *Rainfall rate, *Reflectance, *Remote sensing, Measurements, Microwaves, Precipitation, Rain, Rainfall intensity, Simulation analysis, Weather.

Rain rate estimation properties of multiparameter radar measurements combining radar reflectivity and microwave attenuations were studied through simulations using a two-year disdrometer dataset. In the first simulation, properties of 'complete' multiparameter measurements, where error-free measurements were assumed for each radar resolution cell, were investigated. The results indicated that dual-parameter measurements provide excellent accuracy in rain rate estimation. Most of the dual-parameter measurements possible from space were 'semi-' dual parameter measurements, defined as dual-parameter measurements in which spatial resolution for the attenuation measurement is coarser than the resolution required for rain profiling. Considering this fact, a 'semi-' dual-parameter simulation was also made. The 'semi-' dual-parameter measurement was an extension of the concept of the dual-parameter measurement in terms of the spatial resolution, and provided information on raindrop size distribution by employing a 'two-scale' raindrop size distribution model. It was shown that 'semi-' dual-parameter measurement provided an improved rain rate estimation that was dependent on the resolution of the attenuation measurement. Simulation results allow an evaluation to be made of the effect of raindrop size distribution variations on rain rate profiling from space. (Author's abstract)
W91-12388

HYDROMETEOROLOGICAL FORECASTING AND REMOTE CONTROL AT ELECTRICITE DE FRANCE (PREVISION ET TELESURVEILLANCE HYDROMETEOROLOGIQUE A EDF).
Electricite de France, Grenoble. Div. Technique.
For primary bibliographic entry see Field 7B.
W91-12420

GLOBAL SCALE HYDROLOGY: ADVANCES IN LAND SURFACE MODELING.
Princeton Univ., NJ. Water Resources Program.
For primary bibliographic entry see Field 2A.
W91-12504

MESO-BETA-SCALE POTENTIAL VORTICITY ANOMALIES AND RAINBANDS. PART I: ADIABATIC DYNAMICS OF POTENTIAL VORTICITY ANOMALIES.
Toronto Univ. (Ontario). Dept. of Physics.
D. S. T. Chan, and H. R. Cho.
Journal of the Atmospheric Sciences, Vol. 46, No. 12, p 1713-1723, June 15, 1989. 101 fig, 11 ref.

Descriptors: *Atmospheric circulation, *Climatology, *Meteorology, *Rainfall distribution, *Vorticity, Anomalies, Mesoscale convection, Precipitation, Rain, Rainfall.

The dynamics of mesoscale anomalies in the potential vorticity field is examined in a two-dimensional, semigeostrophic adiabatic frontogenesis model. Scale analyses and numerical simulations show that height-dependent anomalies can induce significant mesoscale structure in the circulation, which can be a mechanism for the formation of rainbands. It was found that broad and shallow shaped mesoscale anomalies induce more significant perturbations to the ageostrophic circulation than tall and narrow anomalies. The time evolution of the anomalies is also studied and results show that in the mid-levels the mesoscale perturbations on the frontal circulation generally decay with time. This is shown to be the direct consequence of the thermally direct circulations induced by the anomalies when forced by a deformation flow at the synoptic scale. (See also W91-09790) (Author's abstract)
W91-12532

ESTIMATING CLOUD WATER DEPOSITION TO SUBALPINE SPRUCE-FIR FORESTS: I. MODIFICATIONS TO AN EXISTING MODEL.
Tennessee Valley Authority, Muscle Shoals, AL.
S. F. Mueller.
Atmospheric Environment ATENBP, Vol. 25A, No. 5/6, p 1093-1104, 1991. 8 fig, 3 tab, 26 ref, append. EPA Cooperative Agreement 813-934010.

Descriptors: *Acid rain, *Cloud liquid water, *Conifers, *Forests, *Model studies, *Mountains, *Precipitation, Analytical methods, Canopy, Deposition, Trees, Water chemistry.

A previously published steady-state model for computing cloud water deposition to a subalpine balsam fir (Abies balsamea) forest was modified for more generalized application to spruce-fir forests. One modification provided options for describing the cloud droplet size spectrum using observed relationships, in the vicinity of high elevation forests, between cloud liquid water content and the distribution of droplet size. Another modification implemented an optional experimental droplet collection efficiency parameterization scheme. This scheme computes collection efficiency for the most dense portion of a tree by treating it as a bulk collector rather than a multi-component (stems, branches, etc.) structure for which collection efficiency is determined by the individual collection efficiencies of its components. A study of model sensitivity to various physical parameterizations revealed that computations of gross cloud water flux to a canopy are most sensitive to canopy inhomogeneity, the relationship between cloud liquid water content and droplet size spectrum, and droplet collection efficiency. As expected, sensitivity test results also indicated that computed evaporation (and hence, the computed net cloud water flux) of intercepted cloud water from a canopy is strongly dependent on net radiation. The model modifications and sensitivity studies described are the prelude to a test of the model described in a companion paper. (See also W91-12544) (Author's abstract)
W91-12543

ESTIMATING CLOUD WATER DEPOSITION TO SUBALPINE SPRUCE-FIR FORESTS: II. MODEL TESTING.
Tennessee Valley Authority, Muscle Shoals, AL.
S. F. Mueller, J. D. Joslin, and M. H. Wolfe.
Atmospheric Environment ATENBP, Vol. 25A, No. 5/6, p 1105-1122, 1991. 7 fig, 8 tab, 19 ref. EPA Cooperative Agreement 813-934010.

Descriptors: *Acid rain, *Cloud liquid water, *Conifers, *Forests, *Model studies, *Model testing, *Mountains, *Precipitation, Canopy, Deposition, Simulation analysis, Spruce trees, Throughfall, Water chemistry, Wind.

A modified version of a previously published steady-state model for computing cloud water deposition to a subalpine balsam fir (Abies balsamea) forest was tested using water throughfall data collected in a red spruce (Picea rubens) forest on Whitetop Mountain, Virginia. Detailed wind data were collected in two distinctly different spruce stands to define airflow conditions within the forest canopy. Other meteorological and canopy structure data were also collected for use as inputs to the deposition model. Model simulations of cloud deposition during 11 cloud events in the two forest stands revealed that the model performed best when site-specific wind speed profiles and droplet size spectra were used along with an experimental droplet collection efficiency scheme that treats the densest portions of trees as bulk collectors (as opposed to modeling collection efficiency for individual tree components). An analysis of residuals indicated that model errors were most strongly correlated with cloud liquid water content (W), a model input. It is speculated that the correlation with W was due to a combination measurement bias when clouds were thin or intermittent and a model computational bias when the potential (defined by the model) for the vertical turbulent flux of cloud water was high. Overall, computed values (using the optimally-configured model) of net cloud water flux tended to exceed measured throughfall rates by 20-30%, and the model explained 38-68% of the variance in throughfall rate. A comparison between the mechanistic model and a simpler empirical model indicated that the mechanistic model performed no better than its empirical counterpart. (See also W91-12543) (Author's abstract)
W91-12544

SULPHUR INPUTS FROM RAINFALL THROUGHOUT NEW ZEALAND.
Ruakura Agricultural Research Center, Hamilton (New Zealand).
For primary bibliographic entry see Field 5B.
W91-12552

MULTIDIMENSIONAL RAINFALL PARAMETER ESTIMATION FROM SPARSE NETWORK.
Corps of Engineers, Fort Leavenworth, KS.
R. W. Koepsell, and J. B. Valdes.

Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 7, p 832-850, July 1991. 6 fig, 8 tab, 12 ref.

Descriptors: *Meteorology, *Model studies, *Parameter estimation, *Precipitation, *Rainfall, *Streamflow forecasting, *Weather patterns, Brazos River Valley, Cyclones, Simulation models, Stochastic process, Texas.

Rainfall modeling poses one of the greatest challenges to hydrologists and meteorologists interested in improving the analysis of water resource problems. The multidimensional precipitation model provides realistic representations of the rainfall process. The model, however, in its most simplified form requires the numerical evaluation of nine parameters. A parameter estimation procedure was applied to a small experimental basin with a dense network rain gauges. In the test basin, the same estimation procedure was attempted over a larger area where only a sparse rain-gauge network was available. Parameter estimates were determined for cyclonic-midlatitude and convective storms, which are characteristic of the winter and summer rain seasons over the test basin. Using the seasonal storm parameter estimates, multidimensional model storms were generated over the Brazos Valley in Texas, and the storms were assessed qualitatively. (Author's abstract)
W91-12560

HOMOGENEITY OF SPATIAL CORRELATION STATISTICS OF TROPICAL OCEANIC RAINFALL.

Texas A and M Univ., College Station. Dept. of Meteorology.
K. S. Shin, and G. R. North.

Journal of Geophysical Research (C) Oceans JGRCEY, Vol. 96, No. 5, p 9273-9283, May 15, 1991. 10 fig, 1 tab, 25 ref. NASA Goddard Space Flight Center Grant 5-869.

Descriptors: *Climatology, *Data interpretation, *Meteorology, *Rainfall, *Remote sensing, *Satellite technology, *Statistical analysis, Atlantic Ocean, Cloud liquid water, Data acquisition, Homogeneity, Microwaves, Oceans, Pacific Ocean, Radiometry, Temperature, Tropical regions.

The possibility of uniform horizontal correlation scales for tropical oceanic rainfall has been examined by a study of satellite-observed microwave data as a proxy measure of rain rates. From the brightness temperatures from the electrically scanning microwave radiometer on Nimbus 5 near nadir during the year of 1974, the mean spatial autocorrelation function as a function of simultaneous pixel separation (25 km pixel contiguous center-to-center spacing) was calculated in each 5 degree by 5 degree grid box over the tropical Pacific and Atlantic for each season. The equal-time spatially lagged correlations were compared for geographical dependence to investigate the hypothesis of homogeneity. A simple model of the spatial statistics of the microwave brightness temperatures was used, consisting of a mixture uncorrelated spatial white noise incoherently superimposed on a spatially correlated field (spatial red noise). The red noise signals are presumed to be generated by convective activity in the tropical atmosphere. The parameters of the red noise are consistent with this scheme over the tropical oceans, yielding a uniform spatial scale of about 50 km throughout. The authors believe the red noise field in the microwave data is due mainly to rainfall, but some contributions from cloud liquid water and water vapor amount in the atmosphere are also possible. (Author's abstract)
W91-12826

YEAR-TO-YEAR VARIATION OF SNOW COVER AREA IN THE NORTHERN HEMISPHERE.

Kyoto Univ. (Japan). Geophysical Inst.
For primary bibliographic entry see Field 2C.
W91-12891

MODELING CASE STUDY OF INTERACTION BETWEEN HEAVY PRECIPITATION AND A LOW-LEVEL JET OVER JAPAN IN THE BAIU SEASON.

Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences.
M. Nagata, and Y. Ogura.

Monthly Weather Review MWREAB, Vol. 119, No. 6, 1309-1336p , June 1991. 24 fig, 2 tab, 46 ref, append. NSF Grant Nos. ATM-8419811 and ATM-8700778.

Descriptors: *Aircraft, *Case studies, *Meteorology, *Model studies, *Precipitation intensity, Advection, Atmospheric circulation, Convective precipitation, Japan, Simulation analysis, Synoptic analysis.

A simulation analysis was conducted for a case of heavy precipitation that occurred on 23 July 1982 over western Japan. Special emphasis was placed on synoptic-scale and subsynoptic-scale processes that led to heavy precipitation and also its linkage with the low-level jet (LLJ). The model result recaptures the major observed features of this event reasonably well. The sequence of events revealed by the model starts with the formation of a localized surface warm front caused by the deformation field that is associated with an eastward traveling, non-deepening meso-alpha-scale low. It is followed by the initiation of both concentrated convective precipitation at the surface front, and stratiform, grid-scale precipitation along the sloping frontal surface. The simulations with different model physics reveal significant roles that diabatic heating processes play in the linkage between heavy precipitation and the LLJ. While condensation heating produces a cyclonic circulation with falling pressure manifested as a mesoscale trough over the front, evaporative cooling from stratiform raindrops generates a marked frontogenetic forcing and creates a cold pool beneath the sloping frontal surface. An anticyclonic outflow from the cold pool is accompanied by convergence on its southwestern flank, which further enhances and concentrates the convective activity and the mesoscale trough. A supergeostrophic LLJ is formed in this situation, where an air parcel crosses height contours into low outflow anomaly induced by the evaporative cooling, and a cross-front flow in the upper branch of the direct secondary circulation associated with the warm-frontogenetical processes. Isentropic and isobaric ageostrophic motion diagnoses show that the inertial advective component, mainly arising from the horizontal displacement, is the dominant part in the ageostrophic wind in the entrance region of the LLJ, supporting the conclusion that the rapid parcel acceleration itself occurs almost adiabatically through the horizontal displacement crossing into low pressure. (Author's abstract)
W91-12892

8-YEAR RECORD OF THE SEASONAL VARIATION OF 2-H AND 18-O IN ATMOSPHERIC WATER VAPOUR AND PRECIPITATION AT HEIDELBERG, GERMANY.

Heidelberg Univ. (Germany, F.R.). Inst. fuer Umweltphysik.
For primary bibliographic entry see Field 2K.
W91-12902

SCAVENGING OF TWO DIFFERENT TYPES OF MARINE AEROSOL PARTICLES CALCULATED USING A TWO-DIMENSIONAL DETAILED CLOUD MODEL.

Mainz Univ. (Germany, F.R.). Inst. for Atmospheric Physics.
A. I. Flossmann.

Tellus TELLAL, Vol. 43, No. B3, p 301-321, July 1991. 12 fig, 4 tab, 53 ref. Ministry for Research and Technology of the Federal Republic of Germany Project 325-4007-0704580, and German National Science Foundation Project SFB 233.

Descriptors: *Acid rain, *Aerosols, *Cloud chemistry, *Cloud physics, *Model studies, *Path of pollutants, Chemical reactions, Chemistry of precipitation, Convection, Marine environment, Rain scavenging, Sodium chloride, Sulfates, Tropical regions.

Two different chemical species ((NH4)2SO4 and NaCl) of aerosol particles were followed in the air, inside the drops in a cloud, and inside the drops reaching the ground during a warm precipitating convective cloud at Day 261 (18 September 1974) of the GATE (GARP Atlantic Tropical Experiment) campaign, to evaluate a 2-dimensional dynamic model including spectral microphysics and scavenging. Model results agree quite well with available observations. The cloud rained after 19 min of cloud life time. For the considered aerosol loading of the atmosphere, rough estimates were derived for the total material processed by a warm convective cloud, as input for larger scale models. In particular, the following conclusions could be drawn for the situation considered: (1) if a drop spectrum forms on an aerosol spectrum where the small particles consist of (NH4)2SO4 and the large ones of NaCl, the resulting small drops also mainly consist of (NH4)2SO4 and the larger drops of NaCl; (2) the mixing ratio of aerosol material in the drops is a function of the age of the drops and their history and therefore the variation of the mixing ratio with drop size depends on the entrainment and evolution of the relative humidity; (3) assuming that the sulfate aerosol would not consist of (NH4)2SO4 particles but instead consist of NH4HSO4 particles, the acidic cloud water has a pH of 4.7 which agrees with observations of marine precipitation; (4) the scavenging efficiency of the cloud considered is closely related to its precipitation efficiency (both near 40%). About 90% of the total amount of aerosol material scavenged is incorporated into the cloud water through nucleation scavenging. About 30% of the aerosol material in the rain at the ground is due to scavenging below cloud base; and (5) the scavenging coefficient of the considered storm was on the order of 0.0001/sec. Differences between two commonly used formulations for calculating the scavenging coefficient can be explained in terms of humidity changes of the atmosphere. (Author's abstract)
W91-12903

2C. Snow, Ice, and Frost

PRELIMINARY FORECAST OF THE ADVANCE OF HUBBARD GLACIER AND ITS INFLUENCE ON RUSSELL FIORD, ALASKA.

Geological Survey, Anchorage, AK. Water Resources Div.
D. C. Trabant, R. M. Krimmel, and A. Post.

Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4172, 1991. 34p, 18 fig, 33 ref.

Descriptors: *Alaska, *Glacier-dammed lakes, *Glaciers, *Glaciology, Ablation, Calving glacier cycle, Climatology, Glacier surges, Hydrological regime, Ice, Icebergs, Lakes, Mass flux, Overflow, Surges, Tides.

Hubbard Glacier, Alaska, has been in the strongly advancing phase of the calving glacier cycle since about 1895. The advance has generally accelerated during the 20th century and blocked the entrance to Russell Fiord in May 1986. The ice and moraine dam failed in October 1986. Another closure is forecast for this decade. If the dam does not fail or is not overtopped, water will overflow into the Situk River near Yakutat, Alaska. The glacier advance is sustained by an accumulation-area to total-glacier-area ratio of 0.95 that results in an estimated mass flux out of the accumulation area of 6.8 cu km/yr. The position of the calving terminus is related directly to ice speed and the rate at which the terminal moraine is moved, and indirectly to water depth at the terminus. Ice speeds are about 3 km/yr near the terminus and vary seasonally. Speed pulses affect the entire lower glacier. Seasonal advance and retreat of the calving terminus is superimposed on the general advance. The closure forecast is based on an understanding of the generalizing calving glacier cycle, an assessment of Hubbard Glacier's present status in that cycle, and observations that suggest how seasonal speed changes, speed pulses, fiord bathymetry, and tidal fluxes near the damming point may affect future closures. Episodic dam formations and failures are expected to result in intermittent overflow reach-

ing the Situk River before a lasting dam is established. (USGS)
W91-11921

SEISMIC REFLECTION INVESTIGATION OF KALAMALKA LAKE: A 'FIORD LAKE' ON THE INTERIOR PLATEAU OF SOUTHERN BRITISH COLUMBIA.
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W91-11977

THEORETICAL DETERMINATION OF THE CHARACTERISTIC EQUATION OF SNOW IN THE PENDULAR REGIME.
British Antarctic Survey, Cambridge (England).
For primary bibliographic entry see Field 7C.
W91-11982

TEMPERATURE DISTRIBUTION OF GLACIERS IN CHINA.
Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Geocryology.
M. Huang.
Journal of Glaciology JOGLAO, Vol. 36, No. 123, p 210-216, 1990. 7 fig, 3 tab, 26 ref.

Descriptors: *China, *Glaciers, *Glaciology, *Temperature, Air temperature.

Since 1959, every major investigation on glaciers in China has included temperature measurements. To date, the temperatures of 22 glaciers in China have been measured. It has been suggested that the minimum temperature at the base of the active layer in the upper part of the ablation area be used as a characteristic temperature, to be compared with the mean annual air temperature. Polar-type glaciers are characterized by low temperatures with a minimum temperature close to the mean annual air temperature, and a cold base in general. Sub-polar-type glaciers generally have a minimum temperature higher than the mean annual air temperature, and a melting base usually located beneath the middle of the ablation area. Temperate-type glaciers typically have a minimum temperature higher than the mean annual air temperature, and a subfreezing near-surface layer in the ablation area year round. (Collins-PTT)
W91-11983

NUMERICAL SIMULATION OF POWDER-SNOW AVALANCHES.
Technological Univ. of Nagaoka (Japan). Faculty of Engineering.
Y. Fukushima, and G. Parker.
Journal of Glaciology JOGLAO, Vol. 36, No. 123, p 229-237, 1990. 5 fig, 24 ref. NSF Grant EAR8213045 and Sea Grant DOC/NA82AA-D-0039.

Descriptors: *Avalanches, *Mathematical models, *Model studies, *Snow, *Snow depth, Computer models, Japan, Kinetic energy, Model testing, Momentum equation, Numerical analysis, Simulation models, Turbulent flow.

Appropriate expressions describing the motion of powder-snow avalanches were derived using a model comprised of four equations--the conservation equations of fluid mass, snow-particle mass, momentum of the cloud, and kinetic energy of the turbulence. Insofar as the density difference between the avalanche and the ambient air becomes rather large compared with the density of the ambient air, the Boussinesq approximation, which is typically used to analyze density currents, was not able to be used. Unlike previous models, the total buoyancy of a powder-snow avalanche was allowed to change freely via erosion from and deposition on to a static snow layer on a slope, the snow-particle entrainment rate from the slope is directly linked to the level of turbulence. A discontinuous, large-scale powder-snow avalanche occurred on 26 January 1986 near Maseguchi, Niigata Prefecture, Japan. The avalanche appears to have had a dense core at its base. The present model was employed to simulate that part of the avalanche above any dense core; the depth of the layer of fresh snow was considered to be an important parameter in the model. The model provided a resonable description of the powder-snow avalanche generated near Maseguchi, and found that the larger the depth of fresh snow, the larger the concentration of snow attained in the avalanche, and the faster its speed. In particular, the model prediction that a powder-snow avalanche strong enough to reach Maseguchi requires a depth of fresh snow of at least 2 meters was found to be in agreement with the observed depth just before the event. (Author's abstract)
W91-11984

ANALYSIS AND MODELING OF MELT-WATER REFREEZING IN DRY SNOW.
Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.
W. T. Pfeffer, T. H. Illangasekare, and M. F. Meier.
Journal of Glaciology JOGLAO, Vol. 36, No. 123, p 238-246, 1990. 9 fig, 1 tab, 20 ref. CO2 Research Division of the U.S. Department of Energy Grant DE-FG0287ER60570.

Descriptors: *Freezing, *Global warming, *Infiltration, *Mathematical models, *Model studies, *Refreezing, *Runoff forecasting, *Snow, *Snowmelt, Capillarity, Finite element method, Flow rates, Glaciers, Mass transport, Numerical analysis, Runoff, Temperature.

A dynamic zone of thermal disequilibrium is described which separates wet snow at 0 C from dry, sub-freezing snow. The dynamic zone tends to be eliminated by thermal equilibrium through freezing, but is sustained and propagated into the sub-freezing snow by water flow from the wet snow. The width of the dynamic zone is controlled by the rate of water inflow, and by the rate of freezing of water onto sub-freezing ice grains; this, in turn, is controlled by the ice/water geometry. Two ice/water geometries were investigated: isolated ice spheres and capillary tubes of ice into which water is pulled by capillary suction. The rate of freezing of water was calculated for the two models for various initial dimensions and temperatures. Equilibrium times were found to be short, typically about 0.5 seconds, but depended on the assumed geometry (sphere or capillary), and were poorly constrained by existing data. Equilibrium times and freeze-on mass fluxes can be calculated for a variety of general conditions, although the results from the capillary geometry will be very hypothetical. This data can then be used in numerical models of wetting-front propagation into cold snow. (Collins-PTT)
W91-11985

CASE HISTORIES OF ATTEMPTS TO REMOVE THREE SMALL ICE JAMS.
British Columbia Ministry of Environment, Kamloops. Water Management.
P. F. Doyle.
Canadian Journal of Civil Engineering CJCEB8, Vol. 18, No. 2, p 331-335, April 1991. 4 fig, 7 ref.

Descriptors: *British Columbia, *Flood control, *Floods, *Ice jams, Blasting, Case studies, Construction equipment, Nicola River, Similkameen River.

From time to time in British Columbia, ice jams cause overbank flooding in rivers that have populated floodplains. Experiences in removing three ice jams were reviewed: two were on the Nicola River (1984) and one was on the Similkameen River (1986). Blasting proved ineffective in removing one ice jam and mechanical removal by heavy equipment at three ice jam locations had mixed results in reducing flood levels or accelerating jam removal. In all cases, diminishing discharge in conjunction with thermal deterioration of the jammed ice gradually had reduced the flooding problems at all sites prior to the earnest efforts to remove these jams. Frequently, there are environmental drawbacks to both blasting and mechanical removal techniques as well as other difficulties (e.g, access and safety) that can combine to make the utility of these ice jam control methods doubtful in many instances. (Author's abstract)
W91-12090

DYNAMIC SEDIMENTATION PROCESSES IN A GLACIER-FED LAKE, PEYTO LAKE, ALBERTA, CANADA.
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
For primary bibliographic entry see Field 2J.
W91-12177

SEARCHING FOR CHAOTIC DYNAMICS IN SNOWMELT RUNOFF.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
B. P. Wilcox, M. S. Seyfried, and T. H. Matison.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1005-1010, June 1991. 7 fig, 1 tab, 32 ref.

Descriptors: *Chaos(theory), *Chaotic dynamics, *Mathematical studies, *Runoff, *Snow, *Snowmelt, Algorithms, Idaho, Time series analysis, Watersheds.

The Grassberger-Procaccia algorithm (GPA) was used to evaluate a runoff time series from a second-order catchment in southwestern Idaho for chaotic dynamics. GPA can identify the presence of low-dimensional chaotic dynamics for experimental time series. A daily runoff record, 8800 days in length, was examined. No evidence of chaotic dynamics in snowmelt runoff was found. Snowmelt runoff measured at a daily time step had a large number of degrees of freedom, which is characteristic of a random rather than chaotic process. These results suggest that the random-appearing behavior of snowmelt runoff is generated from the complex interactions of many factors, rather than from low-dimensional chaotic dynamics. (Author's abstract)
W91-12216

SNOW HYDROLOGY OF A HEADWATER ARCTIC BASIN: I. PHYSICAL MEASUREMENTS AND PROCESS STUDIES.
Alaska Univ., Fairbanks. Water Research Center.
D. L. Kane, L. D. Hinzman, C. S. Benson, and G. E. Liston.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1099-1109, June 1991. 7 fig, 2 tab, 29 ref.

Descriptors: *Alaska, *Arctic zone, *Hydrologic cycle, *Runoff, *Snow, *Snowmelt, *Watersheds, Annual precipitation, Cold regions, Evaporation, Hydrologic properties, Hydrology, Snowpack, Soil water.

The hydrologic cycle of an arctic watershed is dominated by such physical elements as snow, ice, permafrost, seasonally frozen soils, wide fluctuations in surface energy balance, and phase change of snow and ice to water. Hydrologic data collected over a 5-year period (1985-1989) from an arctic watershed in northern Alaska indicate that the total water content of the snowpack at the end of winter comprised between 28 and 40% of the annual precipitation. Redistribution of snow on the ground by the wind is a major factor increasing the snowmelt runoff. Much of the redistributed snow accumulates in the valley bottom along the stream and also along depressions on the hillslopes. These depressions are small surface drainage channels that are referred to as water tracks. Partitioning of the snowmelt into runoff, evaporation and increased soil water storage in the active layer was carried out on the plot and watershed scale. Over the 5-year period, the volume of snowmelt runoff varied from 50 to 66% of the average watershed snowpack, while evaporation varied from 20 to 34% and soil moisture storage increased between 10 and 19%. Much greater variation in these hydrologic components occurred at the plot scale. (See also W91-12227) (Author's abstract)
W91-12226

SNOW HYDROLOGY OF A HEADWATER ARCTIC BASIN: II. CONCEPTUAL ANALYSIS AND COMPUTER MODELING.
Alaska Univ., Fairbanks. Water Research Center.

L. D. Hinzman, and D. L. Kane.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1111-1121, June 1991. 10 fig, 3 tab, 31 ref.

Descriptors: *Alaska, *Arctic zone, *Computer models, *Hydrologic cycle, *Hydrologic models, *Model studies, *Snow, *Snowmelt, *Watersheds, Cold regions, Hydrologic properties, Hydrologic regime, Hydrology, Imnavait Watershed, Runoff, Simulation analysis, Snowpack.

The hydrologic regime of the Imnavait watershed, Alaska, was investigated using the HBV model, a conceptual runoff model designed for continuous calculation of runoff using a lumped parameter representation. Data collected over a five-year period (1985-1989) were used in the analysis. Given measurements of initial snowpack water content and air temperature, the model functioned well in predicting streamflow timing and volumes. The model functioned well in all scenarios with all the parameters the same between simulations except the threshold temperature, TT, and a parameter in the transformation function, MAXBAS. These parameters need to be adjusted to reflect snowpack properties which vary from year to year. The initiation of melt could be controlled by TT and the amount cf snow damming was affected by MAXBAS. Snow damming was an important consideration in the timing of initiation of snowmelt runoff. It is concluded that extensive data collection and analysis are required before hydrologic modeling becomes operational in the Alaskan Arctic. (See also W91-12226) (MacKeen-PTT)
W91-12227

GLACIAL ICE COMPOSITION: A POTENTIAL LONG-TERM RECORD OF THE CHEMISTRY OF ATMOSPHERIC DEPOSITION, WIND RIVER RANGE, WYOMING.
Geological Survey, Cheyenne, WY.
D. L. Naftz, J. A. Rice, and J. R. Ranville.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1231-1238, June 1991. 5 fig, 2 tab, 24 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Glaciers, *Pollutant identification, *Wind River Range, *Wyoming, Calcium, Chlorides, Data acquisition, Ice composition, Knife Point Glacier, Sulfates.

During a reconnaissance study, ice samples were collected from Knife Point glacier in Wyoming to determine if glaciers in the Wind River Range could provide a long-term record of the chemical composition of wet deposition. Eight annual ice layers comprising the years 1980-1987 were identified. The concentration of calcium, chloride, and sulfate in the annual-weighted wet deposition samples collected at the National Atmospheric Deposition Program (NADP) station near Pinedale, Wyoming, showed a significant, positive correlation to the concentration of the same major ions in composite samples from the annual ice layers. Results of the study imply that continuous ice cores reaching to the deeper parts of glaciers in the Wind River Range could provide long-term records of the chemical composition of wet deposition. (Author's abstract)
W91-12237

SNOW ACCUMULATION AND DISTRIBUTION IN AN ALPINE WATERSHED.
California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
K. Elder, J. Dozier, and J. Michaelsen.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1541-1552, July 1991. 6 fig, 10 tab, 24 ref.

Descriptors: *California, *Emerald Lake Watershed, *Mountain watersheds, *Snow accumulation, *Snow cover, *Snow water equivalence, Ablation, Alpine regions, Data interpretation, Mapping, Radiation, Sierra Nevada, Slopes, Statistical analysis.

Distribution of snow water equivalence (SWE) was measured in the Emerald Lake watershed located in Sequoia National Park, California, by taking hundreds of depth measurements and density profiles at six locations during the 1986, 1987 and 1988 water years. A stratified sampling scheme was evaluated by identifying and mapping zones of similar snow properties on the basis of topographic parameters that account for variations in both accumulation and ablation. Elevation, slope, and radiation values calculated from a digital elevation model were used to determine the zones. Of the variables studied, net radiation was of primary importance. Field measurements of SWE were combined with the physical attributes of the watershed and clustered to identify similar classes of SWE. The entire basin was then partitioned into zones for each survey date. Statistical analysis showed that partitioning the watershed on the basis of topographic and radiation variables does produce superior results over a simple random sample. (See W91-12329) (Author's abstract)
W91-12330

ACCURACY OF SELECTED TECHNIQUES FOR ESTIMATING ICE-AFFECTED STREAMFLOW.
Geological Survey, Madison, WI.
For primary bibliographic entry see Field 7B.
W91-12356

DRIFT OF BENTHIC INVERTEBRATES IN SALMON-PRODUCING RIVERS OF EUROPEAN NORTH USSR DURING THE ICE-COVERED PERIOD (IN RUSSIAN).
Akademiya Nauk SSSR, Syktyvkar. Inst. Biologii.
V. N. Shubina, and V. G. Martinov.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 26, No. 6, p 27-31, 1990. 2 fig, 2 tab, 11 ref. English summary.

Descriptors: *Benthic fauna, *Benthos, *Ice drift, Flies, Ice, Insects, Invertebrates, Mayflies, River flow, River ice, River mechanics, Rivers, Stoneflies, Stream biota.

The downstream drift of benthic invertebrates in the Warzuga (Kola peninsula) and Shchugor (North-Ural tributary of the river Pecchora) Rivers, in the ice cover period, were investigated. The drift was composed of Ephemeroptera, Plecoptera and Diptera larvae. The abundance of invertebrates and the number of systematic groups of drift decreased in the ice cover period. A clearly pronounced diurnal rhythm of downstream migration of invertebrates was evident with the maximum abundance occurring at night. Specific aspects of invertebrates diurnal activity, between systematic groups, was also investigated. (Author's abstract)
W91-12375

WATER TEMPERATURE DYNAMICS AND HEAT TRANSFER BENEATH THE ICE COVER OF A LAKE.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2H.
W91-12487

RECENT PROGRESS IN SNOW AND ICE RESEARCH.
Cold Regions Research and Engineering Lab., Hanover, NH.
J. A. Richter-Menge, and S. C. Colbeck.
Reviews of Geophysics RVGPB4, Vol. Supp, p 218-226, 1991. 355 ref.

Descriptors: *Climatology, *Ice, *Literature review, *Model studies, *Polar hydrology, *Snow, Climatic effects, Ice loads, Polar regions, Precipitation, Remote sensing, Research priorities, Seasonal variation.

Snow and ice research during the past quadrennial covers a wide range of topics varying from the climatic effects of large ice sheets and sea ice covers to applied problems such as the icing of power lines and communication facilities. This literature review focuses in more detail on three topics of the many subjects investigated to provide a more coherent look at the advances of achieved and prospects for the future. These are: the influences of layers in seasonal snow covers; research in mechanics on freshwater and sea ice; and remote sensing of polar ice sheets. These topics provide useful examples of the general needs in snow and ice research applicable to most areas, e.g. better representation in models of detailed processes, careful controlled laboratory experiments to quantify processes, and field studies to provide the appropriate context for interpretation of processes from remote sensing. (Author's abstract)
W91-12507

ENVIRONMENTAL EFFECTS ON CO2 EFFLUX FROM WATER TRACK AND TUSSOCK TUNDRA IN ARCTIC ALASKA, U.S.A.
Florida International Univ., Miami. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-12539

SEASONAL VARIATIONS IN THE CONCENTRATION OF BE-10, CL(-), NO3(-), SO4(2-), H2O2, PB-210, H-3, MINERAL DUST, AND DELTA O-18 IN GREENLAND SNOW.
Bern Univ. (Switzerland). Physikalisches Inst.
For primary bibliographic entry see Field 5A.
W91-12541

SPATIAL AND TEMPORAL VARIABILITY OF RIME ICE AND SNOW CHEMISTRY AT FIVE SITES IN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
For primary bibliographic entry see Field 5A.
W91-12542

MATHEMATICAL MODEL FOR RIVER ICE PROCESSES.
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
A. M. W. Lal, and H. T. Shen.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 7, p 851-867, July 1991. 3 fig, 2 tab, 22 ref, 2 append. U. S. Army Cold Regions Research and Engineering Laboratory Contract No. DACA 89-84-K-0008.

Descriptors: *Floating, *Ice breakup, *Ice formation, *Mathematical models, *Model studies, *River ice, Finite difference methods, Ice-water interfaces, River flow, Simulation models, St Lawrence River, Unsteady flow, Water temperature.

River ice undergoes processes of formation, evolution, transport, dissipation, and deterioration. These processes are affected by atmospheric conditions, river geometry, and interact with the river flow. A computer model RICE is developed for simulating ice processes in rivers. In the river-hydraulics component, the flow condition is determined from one-dimensional unsteady flow equations. In the thermal component, distributions of water temperature and ice concentration are determined from transport equations of thermal energy and ice. Effects of surface ice, skim-ice, and border ice formations on the ice production are considered. The formation of ice cover is formulated according to existing equilibrium ice-jam theories, with consideration to the interaction between the ice cover and the flow. The undercover ice accumulation is formulated according to the critical velocity criteria. The thermal growth and decay of the ice cover is simulated using a finite-difference formulation applicable to composite ice covers consisting of snow, ice, and frazil layers. The model can be used to provide a continuous description of river ice development based on a limited amount of field data and can assist engineers in evaluating the possible beneficial and detrimental consequences of ice-control structures and flow regulation. (Author's abstract)
W91-12561

YEAR-TO-YEAR VARIATION OF SNOW COVER AREA IN THE NORTHERN HEMISPHERE.
Kyoto Univ. (Japan). Geophysical Inst.
T. Iwasaki.
Journal of the Meteorological Society of Japan

JMSJAU, Vol. 69, No. 2, p 209-217, April 1991. 10 fig, 22 ref. Japan Society for the Promotion of Science for Japanese Junior Scientists Grant No. 02952105.

Descriptors: *Annual precipitation, *Climatology, *Remote sensing, *Snow cover, *Statistical analysis, Asia, Correlation analysis, Europe, North America, Satellite technology, Seasonal variation, Snow.

An exploratory investigation was conducted of the inter-annual variability of winter snow cover in the Northern Hemisphere, using satellite-derived monthly snow cover data from 1967 to 1987. An empirical orthogonal function (EOF) analysis was made to find the typical pattern of snow cover variations during winter. The first component of the EOF (EOF1), which represented 46.6% of the total variance, shows concurrent snow cover patterns between Eurasia and North America. The time series of the EOF1 is similar to that of total winter snow cover in the Northern Hemisphere. The second component of the EOF (EOF2), which represents 23.6% of the total variance, shows a negatively correlated pattern between the eastern and western parts of Eurasia, and also shows a negatively correlated pattern between the eastern Eurasia and North America. This EOF2 shows the importance of subcontinental-scale snow variations as a climatic control to a large continent. The time series of mean snow cover for the representative areas depicted in the EOF patterns were investigated to determine the persistency of snow cover in more detail. Snow cover features for a specific year (e.g., a heavy or light snow year) were likely to be sustained during December to February and disappear in March. A significant decrease of the snow cover area from February to March in a heavy snow year, was found to occur in eastern Eurasia. Two key regions were selected which represent continental-scale snow variation: one is the eastern part of Eurasia, and the other is North America. The time series of the two key regions shows an apparent 1-yr lag relationship between snow years; winters with extensive snow cover over Eurasia, tend to be followed by relatively heavier snow cover over North America during the succeeding winters. (Author's abstract)
W91-12891

2D. Evaporation and Transpiration

SIMULATION OF EVAPOTRANSPIRATION BY TREES.
Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Forestry and Forest Products.
R. Leuning, P. E. Kriedemann, and R. E. McMurtrie.
Agricultural Water Management AWMADF, Vol. 19, No. 3, p 205-221, April 1991. 10 fig, 1 tab, 22 ref.

Descriptors: *Evapotranspiration, *Forests, *Model studies, *Saline soils, *Soil water, *Trees, *Water stress, *Water table profiles, Australia, Humidity, Simulation, Stomatal transpiration, Water vapor.

As a guide to selecting species for lowering water tables in salt-affected drylands in southwestern Australia, a model of plant water consumption was used to simulate seasonal patterns of soil water storage in a forested catchment 200 km south of Perth. Combinations of leaf area index and stomatal sensitivity to humidity were assessed for their impact on water storage levels in two soils with differing water storage capacities. The model predicted that trees with low stomatal sensitivity to water vapor pressure deficit (VPD) or with high leaf area index (LAI) will deplete soil water more rapidly than trees sensitive to VPD or with low LAI. Trees with stomata insensitive to VPD would have to endure longer periods of severe water stress and would be less likely to survive than trees with stomata responsive to VPD. Differences in stomatal sensitivity to humidity resulted in no net annual change in soil water storage when soil moisture holding capacity was small because all water was consumed each year. Assuming plants initially had free access to water, those with stomata insensitive to VPD reduced water table levels more rapidly than species with stomata responsive to VPD. Total water consumption would be the same for both types of plants after a sufficiently long period when a new equilibrium between annual rainfall and evapotranspiration would be reached. (Author's abstract)
W91-11602

SEMIEMPIRICAL MODEL OF BARE SOIL EVAPORATION FOR CROP SIMULATION MODELS.
Institut National de la Recherche Agronomique, Avignon (France). Station de Bioclimatologie.
N. Brisson, and A. Perrier.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 719-727, May 1991. 8 fig, 39 ref.

Descriptors: *Crop simulation models, *Evaporation, *Model studies, *Soil-water-plant relationships, *Water requirements, Climatic data, Drying, Evaporation rate, Mass balance, Soil properties, Transpiration.

In crop simulation models, the water subroutine computes evaporation and transpiration separately. This property allows a greater confidence in the simulation of the early crop stages in terms of water requirements. A semiempirical model of the drying stage of soil evaporation is suggested that can easily be incorporated into various crop models. The model is based on a physical approach, yet it depends solely on permanent soil properties and on some key data on the local climate. The basic theory relies upon the mass balance of a dry surface layer of varying thickness. After successive assumptions on the main limiting factors of the drying process, this process can be described by one equation relating actual to potential evaporation. The advantage of this formula comes from its introducing just one synthetic parameter that can be expressed as the product of two components: a climatic one and a pedological one. When compared with experimental data, the results of the model show that the order of magnitude of the evaporative process is respected, which is required for crop models. (Author's abstract)
W91-11725

DAILY EVAPORATION OVER A REGION FROM LOWER BOUNDARY LAYER PROFILES MEASURED WITH RADIOSONDES.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
M. Sugita, and W. Brutsaert.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 747-752, May 1991. 7 fig, 2 tab, 14 ref. NSF Grant ATM-8619193.

Descriptors: *Boundary layers, *Evaporation, *Hydrologic budget, *Radiosondes, *Remote sensing, Correlation analysis, Energy, Heat flow, Kansas, Profiles, Temperature.

In hydrologic budget calculations, the different terms, including evaporation, are often considered over daily periods. However, measurements of daily evaporation are seldom available. Regional daily evaporation was estimated by means of continuous measurements of the available energy flux at the surface and one or more instantaneous determinations of the evaporative fraction (EF). The data were obtained during the First ISLSCP Field Experiment (FIFE) in northeastern Kansas. EF, which is the ratio of the latent heat flux and the available energy flux, was assumed to be constant during the daylight hours; thus it was determined from only a few instantaneous surface flux values calculated on the basis of radiosonde profiles in the surface layer, together with remotely sensed surface temperature. Comparison of 23 estimated and measured daytime evaporation values showed good correlation, although the evaporation was underestimated by about 5% on average. For practical purposes, this underestimation may be remedied by simply multiplying the daytime value by a coefficient calibrated for the region of interest. In the estimation of daily evaporation, nighttime evaporation must also be considered; measurements by means of the eddy correlation method showed that on average it accounted for some 8% of the total daily evaporation. (Doria-PTT)
W91-11728

EVAPOTRANSPIRATION-INTERCEPTION MODEL FOR URBAN AREAS.
British Columbia Univ., Vancouver. Dept. of Geography.
C. S. B. Grimmond, and T. R. Oke.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1739-1755, July 1991. 11 fig, 7 tab, 75 ref.

Descriptors: *British Columbia, *Evapotranspiration, *Hydrologic budget, *Interceptor sewers, *Mathematical models, *Urban hydrology, Comparison studies, Hydrometeorology, Irrigation, Land use, Model studies, Rainfall, Urban areas, Vancouver.

A model is described which calculates evapotranspiration from urban areas over a wide range of meteorological conditions. An evapotranspiration-interception approach is used because it is necessary to cope with the changing water availability on the surface, during and following rainfall or irrigation. The model is applicable to areas ranging from the size of city blocks to land use zones and time periods of one hour and longer. The modeled evaporation was compared with that from micrometeorological measurements conducted from January to June 1987 in a suburb of Vancouver, British Columbia, Canada, with results showing that this approach to modeling urban evapotranspiration provides realistic hourly and daily estimates of the areally averaged latent heat flux and surface water state. (Author's abstract)
W91-12348

EFFECTS OF PLOUGHLESS TILLAGE AND STRAW INCORPORATION ON EVAPORATION.
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Soil Sciences.
For primary bibliographic entry see Field 3F.
W91-12528

REMOTE DETERMINATION OF SOIL MOISTURE AND EVAPOTRANSPIRATION FROM THERMAL INFRARED MEASUREMENTS: DETECTION OF A DRYING THRESHOLD.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
T. N. Carlson, and J. M. Russo.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-195818. Price codes: A03 in paper copy, A01 in microfiche. Pennsylvania Environmental Resources Research Institute, University Park, Final Report ER9102, March 1991. 17p, 8 fig, 7 ref. USGS Contract No. 14-08-0001-G1490.

Descriptors: *Soil water, *Soil-plant-water relationships, *Water cycle, *Water movement, Drying threshold, Evapotranspiration, Model studies, Remote sensing, Sensitivity analysis, Soil moisture, Thermal infrared measurement, Vegetation, Water measurement, Water stress.

Important objectives in the work were to (1) model the water movement through the soil/plant/atmosphere system; (2) to use, in conjunction with this model, remote measurements of infrared surface temperature and vegetation index to calculate soil water content and; (3) determine whether water stress can be detected radiometrically over vegetation, specifically to identify the threshold at which these measurements may be used for remotely estimating soil water content over both bare soil and vegetation, and to specify the limits of accuracy in the soil water content estimates. Much of the modeling effort has been devoted to improving the vegetation component of the model. Sensitivity tests with the vegetation model suggest that water stress in vegetation may be detectable for a period of a few days prior to wilting, provided that the atmospheric demand is large, an appropriate threshold leaf water potential exists and plant storage capacity is not large. Horizontal variations in radiometric surface temperature over

sparse vegetation may simply reflect horizontal variations in canopy density rather than horizontal variations in soil water content. (USGS)
W91-12628

2E. Streamflow and Runoff

RESPONSE OF MACROINVERTEBRATES TO LOW PH AND INCREASED ALUMINIUM CONCENTRATIONS IN WELSH STREAMS: MULTIPLE EPISODES AND CHRONIC EXPOSURE.
National Rivers Authority, Cardiff (Wales).
For primary bibliographic entry see Field 5C.
W91-11620

ZOOPLANKTON AND SALINITY IN THE RUFIJI RIVER DELTA, TANZANIA.
Dar es Salaam Univ. (Tanzania). Dept. of Zoology and Marine Biology.
For primary bibliographic entry see Field 6G.
W91-11631

RECOLONISATION OF FOUR SMALL STREAMS IN CENTRAL SCOTLAND FOLLOWING DROUGHT CONDITIONS IN 1984.
Freshwater Fisheries Lab., Pitlochry (Scotland).
B. R. S. Morrison.
Hydrobiologia HYDRB8, Vol. 208, No. 3, p 261-267, December 10, 1990. 3 fig, 2 tab, 11 ref.

Descriptors: *Aquatic organisms, *Colonization, *Drought effects, *Invertebrates, *Loch Ard Forest, *Scotland, *Stream biota, *Streams, *Succession, Community structure, Insects, Population density, Seasonal distribution, Species diversity, Statistical analysis.

Four streams in the Loch Ard Forest in central Scotland dried out almost completely during a drought in the summer of 1984. The recovery of the invertebrate populations in the streams was studied from September 1984 until March 1985 when most of the insect larvae belonging to several insect orders within a month of the streams' filling up suggests that they had survived the drought as eggs, or eggs had been laid by adults soon after the drought ended. Statistical analysis showed that with the exception of three taxa, no significant difference existed between the numbers of animals in November 1984 samples and in samples collected in March 1985. Comparison of samples from March 1984 and March 1985 showed significant difference in population size for a few species; with two exceptions the 1984 samples (i.e. before drought) were larger. In the long term, the overall effect of the drought on the invertebrate communities seems to have been limited. (Author's abstract)
W91-11638

EFFECTS OF SPATIALLY-DISTRIBUTED RAINFALL ON RUNOFF FOR A CONCEPTUAL CATCHMENT.
Institute of Hydrology, Wallingford (England).
L. G. Watts, and A. Calver.
Nordic Hydrology NOHYBB, Vol. 22, No. 1, p 1-14, 1991. 6 fig, 11 ref.

Descriptors: *Catchment areas, *Hydrographs, *Hydrologic models, *Model studies, *Rainfall, *Rainfall-runoff relationships, *Runoff, *Storm runoff, Simulation, Slopes, Storms.

A physically-based rainfall-runoff model was used to investigate effects of moving storms on the runoff hydrograph of throughflow dominated idealized catchments. Simulations were undertaken varying the storm speed, direction, intensity, the part of the catchment affected by rainfall, and the spatial definition of rainfall zones. For a 100 sq km catchment, under the circumstances investigated, an efficient spatial resolution of rainfall data is around 2.5 km along the path of the storm. Storms moving downstream produce earlier, higher peaks than do storms moving upstream. Error is most likely to be introduced into lumped-rainfall predictions for slower storm speeds, and the likely direction of this error can be specified. Differences in magnitude of peak response between downstream and upstream storm directions reach a maximum at a storm speed and direction similar to those reported for overland flow dominated catchments, but differences in peak runoff between downstream and upstream storm directions are much smaller where rainfall inputs are modified by a period of hillslope throughflow. (Author's abstract)
W91-11657

DEVELOPMENT OF A PROCESS ORIENTED CALIBRATION SCHEME FOR THE HBV HYDROLOGICAL MODEL.
Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
J. Harlin.
Nordic Hydrology NOHYBB, Vol. 22, No. 1, p 15-36, 1991. 12 fig, 3 tab, 25 ref.

Descriptors: *Computer models, *Hydrologic models, *Model studies, *Runoff forecasting, Calibrations, Catchment areas, Rainfall-runoff relationships.

A process oriented calibration scheme (POC) was developed for the HBV hydrological model. Twelve parameters were calibrated in two steps. First, initial parameter estimates were made from recession analysis of observed runoff. Next, the parameters were calibrated individually in an iteration loop starting with the snow routine, over the soil routine and finally the runoff-response function. This was done by minimizing different objective functions for different parameters and only over subperiods where the parameters were active. Approximately 350 objective function evaluations were needed to find the optimal parameter set, which resulted in a computer time of about 17 hours on a 386 processor PC for a 10-year calibration period. Experiments were also performed with fine tuning as well as direct search of the response surface, where the parameters were allowed to change simultaneously. A calibration period length of between two and six years was found sufficient to find optimal parameters in the test basins. The POC scheme yielded as good model performance as after a manual calibration. (Author's abstract)
W91-11658

DRAINAGE NETWORKS FROM GRID DIGITAL ELEVATION MODELS.
James Madison Univ., Harrisonburg, VA. Dept. of Mathematics and Computer Science.
J. Fairfield, and P. Leymarie.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 709-717, May 1991. 7 fig, 13 ref.

Descriptors: *Digital map data, *Drainage patterns, *Elevation, *Geomorphology, *Remote sensing, *Terrain analysis, Algorithms, Basins, Channels, Data interpretation, Hydrologic models, Noise, Slopes.

Current algorithms that deduce the drainage network from a digital elevation model (DEM) represented by a regular array of surface elevations share a fault: unless the terrain is rugged, the derived water channels tend to flow in parallel lines along preferred directions engendered by the sampling grid orientation. A simple solution to the problem was developed that permits the lines of descent to follow slopes much more accurately. The solution is not expensive to implement. A second difficulty is the presence of noise that creates artificial pits. A newly developed algorithm deals with pits in what is believed to be a more efficient manner for virtual memory environments than previous efforts. The new system has treated DEMs of nearly 9 million pixels. Depth first search of the resulting drainage network permits segregation of the DEM into basins by various criteria, analysis of stream-sediment anomaly dilution profiles, improved hydrologic models, and other applications. (Doria-PTT)
W91-11724

CONVECTIVE ACCELERATIONS AND BOUNDARY SHEAR STRESS OVER A CHANNEL BAR.
California Univ., Berkeley. Dept. of Geology and Geophysics.
P. J. Whiting, and W. E. Dietrich.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 783-796, May 1991. 17 fig, 1 tab, 31 ref. ACS Grant ACS-PRF-18427-AC2.

Descriptors: *Accelerated flow, *Alluvial channels, *Channel morphology, *Convection, *Flow characteristics, *Shear stress, Channel bars, Gravel rivers, Topography, Water depth.

Alternate bars are important features in alluvial channels, as they determine flow and transport patterns. Field results from Solfatara Creek (Yellowstone National Park), a gravel bed channel where flow exits an upstream bend and shoals over a bar in a straight reach, were used to examine patterns of flow and the fluid forces determining the flow field. Large cross-sectional area changes, tied primarily to variation in depth, force large stream-wise accelerations and substantial cross-stream flow off the central bar. The topographically-driven downstream and cross-stream accelerations are sufficiently large that their influence upon the balance of forces is the of the same order as the pressure gradient and the boundary shear stress. The importance of convective accelerations in the downstream flow equation in this straight reach concurs with bend flow results, but the similar importance of convective accelerations in the cross-stream equation contrasts with results from bend flow. While part of the difference may be attributed to the lower stage conditions herein, in the absence of significant curvature change the cross-stream force balance depends upon the flow going over the bar. Local boundary shear stress increases decreases out of the upstream bend, increases over the bar top, and then decreases in deeper flow. Strong bed surface coarsening maintains the topography is a stress field that would otherwise lead to planation of the bar top and filling of the deeper regions. (Author's abstract)
W91-11732

VELOCITY DISTRIBUTION AND BED ROUGHNESS IN HIGH-GRADIENT STREAMS.
Washington Univ., Seattle. Dept. of Geological Sciences.
P. L. Wiberg, and J. D. Smith.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 825-838, May 1991. 10 fig, 2 tab, 24 ref. NSF Grant OCE-8700659; Office of Naval Research Grant N00014-87-K-0160.

Descriptors: *Alluvial channels, *Channel morphology, *Hydraulic roughness, *Model studies, *Stream gradient, *Streamflow, *Velocity distribution, Boundaries, Colorado, Drag, Eddies, Flow around objects, Flow discharge, Model testing, Mountain streams, Particle size, Profiles, Sediment transport, Slope effects, Stress, Viscosity, Water depth.

A model for the velocity field over a poorly sorted bed was derived and applied to flow in steep streams with coarse gravel beds. In such streams, large clasts are often comparable in size to stream depth and act as obstacles to the flow. The effect of these obstacles on a flow is estimated by partitioning total stress, proportional to the depth-slope product, into a purely fluid component and a form-drag component associated with flow around the obstacles. An eddy viscosity closure was used, with a length scale dependent on both distance from the boundary and wake dimension. Resulting velocity profiles agree well with measured profiles, reported in the literature, from nine mountain streams in Colorado. Model runs for a range of conditions reveal that the velocity distribution depends primarily on flow depth (h) and the length of the vertically oriented axis of clasts at the 84th percentile of the grain size distribution (D sub 84z). Calculated values of mean velocity, normalized by shear velocity, are well represented by a simple log linear relationship in terms of relative roughness (D sub 84)/(h). The formulation described for flow over randomly distributed, poorly sorted beds should apply to heterogeneous sediment of any size in streams of any depth. (Author's abstract)
W91-11736

MEASUREMENT OF THE LONGITUDINAL DISPERSION COEFFICIENT NEAR A JUNCTION IN A TIDAL RIVER.
Queensland Univ., Brisbane (Australia). Dept. of Physics.
J. G. Steele.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 839-844, May 1991. 7 fig, 12 ref.

Descriptors: *Dispersion coefficient, *Flow characteristics, *Path of pollutants, *Saline-freshwater interfaces, *Tidal rivers, *Water quality, Australia, Brisbane River, Dissolved oxygen, Profiles, Rainfall, Saline water, Salinity, Tides, Tributaries.

A new method of measuring the longitudinal dispersion coefficient was developed, based on the decay of a step function in a water quality profile near the junction of a tributary with a tidal river. The method requires frequent data during a tidal cycle, so that the slope of the profile at different times can be estimated and compared with the theoretical slope at the same stage of the cycle. The method permits the dispersion coefficient to be deduced in circumstances which, although relatively rare, may complement other methods. This method is only applicable in a tributary in the neighborhood of its junction with a larger river. It depends on the existence of a discontinuity in the profile of salinity or dissolved oxygen concentration at the junction. For example, rainfall in the catchment of the tributary may cause saline water to expelled from the tributary into a larger river. But salinity may remain large in the river itself, so that the salinity profile has the form of a step function at the junction. Tidal flow may cause the step function to move up the tributary on the flood tide; dispersion then causes the step to decay. The method was applied to two tributaries of the Brisbane River (Australia), utilizing salinity and dissolved oxygen data. In the larger tributary, the coefficient was about 27 sq m/s averaged over the tidal cycle. In the smaller tributary, the coefficient was about 10 sq m/s, and a variation in the coefficient during the tidal cycle was indicated. (Doria-PTT)
W91-11737

RUNOFF CHARACTERISTICS OF SAGEBRUSH RANGELANDS: MODELING IMPLICATIONS.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
B. P. Wilcox, M. S. Seyfried, K. R. Cooley, and C. L. Hanson.
Journal of Soil and Water Conservation JSWCA3, Vol. 46, No. 2, p 153-158, March/April 1991. 5 fig, 1 tab, 17 ref.

Descriptors: *Hydrologic models, *Model studies, *Rainfall-runoff relationships, *Rangeland, *Runoff, *Runoff forecasting, Correlation analysis, Elevation, Frost, Hydrologic budget, Sagebrush.

Runoff characteristics of sagebrush rangeland were related to runoff prediction by SWRRB (Simulator for Water Resources in Rural Basins). Precipitation-runoff relationships on five sagebrush watersheds located along a climatic gradient in southwestern Idaho were established using long-term records. Runoff from the two higher elevation watersheds was snowmelt-generated. With decreasing elevation, soil frost was important in runoff generation. Average annual runoff for the five watersheds ranged from 1 mm to 500 mm. The correlation between annual precipitation and annual runoff decreased with aridity of the watershed. SWRRB successfully simulated annual runoff from the highest elevation watershed where (1) runoff made up a high percentage (50%) of the water budget, (2) frozen soil runoff was insignificant, and (3) there was a strong correlation between annual runoff and precipitation. Runoff predictions were poor for the lower elevations watersheds where (1) runoff was a small part (1-7%) of the water budget, (2) frozen soil runoff was very important, and (3) there was a poor correlation between annual runoff and precipitation. For sagebrush rangeland in the Great Basin, little confidence can be placed in runoff predicted from models like SWRRB that are based on curve number hydrology if runoff accounts for a small part (<10%) of the water budget and/or soil frost plays a dominant role in runoff generation. (Author's abstract)
W91-11755

AT-SITE FLOOD FREQUENCY ANALYSIS FOR THAILAND.
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and N. Laungwattanapong.
Water SA WASADV, Vol. 17, No. 2, p 147-154, April 1991. 1 fig, 6 tab, 21 ref.

Descriptors: *Flood forecasting, *Flood frequency, *Statistical analysis, *Thailand, Estimating, Model studies.

At-site flood frequency analysis was carried out for 64 unregulated streamflow stations in various regions of Thailand with each data set having at least 20 observations. The magnitude and standard deviation of the T-year flood were computed for T = 100, 200, 500, and 1,000 years. Using the extreme value type 1 (EV1), general extreme value (GEV) and log-logistic (LLG) distributions as the parent models, along with commonly used methods of parameter estimation, it was found that the GEV is the most suitable distribution, providing a good fit in many cases. The method of probability weighted moments is the most desirable method for parameter estimation in this case because it is less biased and more efficient (expressed by smaller values of the bias and standard deviation of the T-year flood). (White-Reimer-PTT)
W91-11770

INTERCOMPARISON OF HYDROLOGICAL NETWORK-DESIGN TECHNOLOGIES.
Geological Survey, Tucson, AZ.
For primary bibliographic entry see Field 7A.
W91-11792

ESTEVAO CABRAL'S PIONEERING CONTRIBUTION TO OPEN CHANNEL HYDROMETRY.
Technical Univ. of Lisbon (Portugal). Dept. of Civil Engineering.
A. De Carvalho Quintela.
Hydrological Sciences Journal HSJODN, Vol. 36, No. 3, p 241-246, June 1991. 3 fig, 10 ref.

Descriptors: *Biographies, *Channel flow, *Flow velocity, *Hydrometry, *Instrumentation, *Measuring instruments, *Open-channel flow, *Stream gaging, Current meters, Data acquisition, History, Portugal.

In 1786, the Portuguese citizen Estevao Cabral (1734-1811) built a paddle wheel that allowed him to measure water velocity at different depths and then to compute the discharge of rivers. Cabral was the first researcher to use rotating current meters for measuring flow velocity below the water surface; the paddle wheels previously used could measure only surface velocities. He was also the first researcher to state that the velocity in open channel flow increases downward from the surface to a maximum, and then decreases toward the bottom. (Author's abstract)
W91-11794

METHOD OF LOWER-BOUND TO ESTIMATE THE PARAMETERS OF A PEARSON TYPE III DISTRIBUTION.
Chengdu Univ. of Science and Technology (China).
For primary bibliographic entry see Field 7C.
W91-11797

LOW-FLOW CHARACTERISTICS OF STREAMS IN VIRGINIA.
Geological Survey, Richmond, VA.
D. C. Hayes.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225, as Open-File Report 89-586. Prepared in cooperation with the Virginia Water Control Board. 85 p, 8 fig, 2 tab, 44 ref, 4 append, 2 plates.

Descriptors: *Low flow, *Stream gages, *Streamflow, *Streamflow data, *Virginia, Base flow, Drainage area, Flow characteristics, Flow discharge, Flow measurement, Regression analysis, Streamflow forecasting.

Streamflow data were collected and low-flow characteristics computed for 715 gaged sites in Virginia. Annual minimum average 7-consecutive-day flows range from 0 to 2,190 cubic feet per second, having a 2-year recurrence interval and from 0 to 1,420 cubic feet per second for a 10-year recurrence interval. Low-flow characteristics for long-term continuous-record sites are determined from frequency curves of annual minimum average 7-consecutive-day flows. Low-flow characteristics for short-term continuous-record sites are estimated by relating daily mean base flow discharge values at a short-term site to concurrent daily mean discharge values at nearby, long-term continuous-record sites with similar basin characteristics. Low-flow characteristics for partial-record sites are estimated by relating base flow measurements to daily mean discharge values at long-term continuous-record sites. A flow-routing method was developed to estimate low-flow values at ungaged sites on gaged streams, consisting of transferring low-flow characteristics from a gaged site, either upstream or downstream, to a desired ungaged site. Standard errors of the estimate for 108 test sites are 19% of the mean for estimates of low-flow characteristics having a 2-year recurrence interval and 52% of the mean for estimates of low-flow characteristics having a 10-year recurrence interval. A more complex transfer method must be used when major tributaries enter the stream between the gaged and ungaged site. Regional regression equations were developed for estimating low-flow values at ungaged sites on ungaged streams. The state of Virginia was divided into eight regions on the basis of physiography and geographic grouping of residuals computed in regression analyses. Basin characteristics that were significant in the regression analysis were drainage area, rock type, and strip-mined area. Standard errors of prediction range from 60 to 139% for estimates of low-flow characteristics having a 2-year recurrence interval, and 90 to 172% for estimates of low-flow characteristics having a 10-year recurrence interval. (Author's abstract)
W91-11835

HYDROLOGIC DATA OF THE NASHUA AND SOUHEGAN RIVER BASINS, MASSACHUSETTS.
Geological Survey, Boise, ID. Water Resources Div.
B. P. Hansen, R. A. Brackley, and V. de Lima.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225. USGS Open-File Report 87-221, 1989. Massachusetts Hydrologic-Data Report No. 27, 1989. 79p, 8 tab, 20 ref, 1 plate. Prepared in cooperation with the Massachusetts Department of Environmental Management Division of Water Resources.

Descriptors: *Hydrologic data collections, *Massachusetts, *River basins, *Streamflow data, *Water resources data, Groundwater data, Groundwater pollution, Rainfall, Sampling, Solute transport, Stream discharge, Stream pollution, Water pollution, Water quality, Water samples, Water temperature, Well data.

Hydrologic data was collected in the mid-1970s during an investigation of water resources in the parts of the Nashua River basin and the Souhegan River basin which lie in Massachusetts. This data has been tabulated, and includes selected information on wells and test borings; streamflow records; and chemical analyses of surface water, groundwater, and rainfall. A map at a scale of 1:48,000 shows the location of all data sites. Measurements of streamflow at low-flow discharge stations were made during periods when streamflow was primarily from groundwater storage. These measurements, when correlated with the simultaneous discharge of a nearby stream where continuous records are available, will give a picture of the potential low flow of the stream. One water sample may define adequately the water quality in a

stream at a given time if the mixture of solutes throughout the stream cross section is homogeneous. However, the concentration of solutes at different locations in the cross section may differ widely, depending on the rates of water discharge, the source of material, and the turbulence and mixing of the stream. Groundwater quality does not change significantly during short periods of time; infrequent sampling and analysis of groundwater adequately define groundwater quality at a given site. Solids are dissolved from the atmosphere by precipitation. The amount and type of solids may be affected by the source of airborne particles, the wind direction and velocity, and the rainfall intensity and duration. Samples of rainfall were collected during selected periods. Water temperatures were measured at most water quality stations and taken concurrently with most discharge measurements at surface water stations. Large streams have a small daily temperature change while small, shallow streams may have a daily range of several degrees and may follow closely the changes in air temperature. (Fish-PTT)
W91-11840

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990. VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL VALLEY.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11881

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990. VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASINS FROM WALKER RIVER TO TRUCKEE RIVER.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11882

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1990. VOLUME 1. MISSOURI RIVER BASIN, ARKANSAS RIVER BASIN, AND RIO GRANDE BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11884

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1990. VOLUME 2. COLORADO RIVER BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11885

WATER RESOURCES DATA FOR CONNECTICUT, WATER YEAR 1990.
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11886

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990. VOLUME 2A. SOUTH FLORIDA - SURFACE WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11887

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990, VOLUME 2B. SOUTH FLORIDA - GROUND WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11888

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990. VOLUME 4. NORTHWEST FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11889

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1990, VOLUME 1. ILLINOIS EXCEPT ILLINOIS RIVER BASIN.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11890

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1990, VOLUME 2. ILLINOIS RIVER BASIN.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11891

WATER RESOURCES DATA FOR IOWA, WATER YEAR 1990.
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11892

WATER RESOURCES DATA FOR KENTUCKY, WATER YEAR 1990.
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11893

WATER RESOURCES DATA FOR MARYLAND AND DELAWARE, WATER YEAR 1990. VOLUME 1. ATLANTIC SLOPE BASINS, DELAWARE RIVER THROUGH PATUXENT RIVER.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11894

WATER RESOURCES DATA FOR MARYLAND AND DELAWARE, WATER YEAR 1990, VOLUME 2. MONONGAHELA AND POTOMAC RIVER BASINS.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11895

WATER RESOURCES DATA FOR MICHIGAN, WATER YEAR 1990.
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11896

WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1990.
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11897

WATER RESOURCES DATA FOR NEBRASKA, WATER YEAR 1990.
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11898

WATER RESOURCES DATA FOR NEW MEXICO, WATER YEAR 1990.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11899

WATER RESOURCES DATA FOR NORTH CAROLINA, WATER YEAR 1990.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11900

WATER RESOURCES DATA FOR OHIO, WATER YEAR 1990. VOLUME 1. OHIO RIVER BASIN.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11901

WATER RESOURCES DATA FOR OHIO, WATER YEAR 1990. VOLUME 2. ST. LAWRENCE RIVER BASIN.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11902

WATER RESOURCES DATA FOR OKLAHOMA, WATER YEAR 1989.
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11903

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1990, VOLUME 2. WESTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11904

WATER RESOURCES DATA FOR VIRGINIA, WATER YEAR 1990. VOLUME 1. SURFACE WATER AND SURFACE-WATER-QUALITY RECORDS.
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11905

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1990.
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11906

WATER RESOURCES DATA FOR WYOMING, WATER YEAR 1990.
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11907

SUMMARY OF HYDROGEOLOGIC, WATER-QUALITY, AND BIOLOGIC DATA FROM TWO SMALL BASINS, SOUTHEAST HILLSBOROUGH COUNTY, FLORIDA.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11925

HYDROLOGIC DATA FOR THE JEMEZ MOUNTAINS, NEW MEXICO.
Geological Survey, Albuquerque, NM.
For primary bibliographic entry see Field 2F.
W91-11926

WATER RESOURCES ACTIVITIES IN FLORIDA, 1990-91.
Geological Survey, Little Rock, AR. Water Re-

sources Div.
M. E. Glenn.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-78, 1991. 84p, 6 fig.

Descriptors: *Florida, *Urban hydrology, *Water resources, *Water resources data, *Water resources investigations, Groundwater, Handbooks, Publications, Surface water, Water quality, Water yield.

Water resources activities in Florida conducted by the Water Resources Division of the U.S. Geological Survey in cooperation with Federal, State, and local agencies during 1990 are part of the Federal program of appraising the Nation's water resources. Included are brief descriptions of the nature and scope of all active studies, summaries of significant results for 1990, and anticipated accomplishments during 1991. The interpretive reports and records that are products of the investigations are a principal hydrologic foundation upon which the plans for development, management, and protection of Florida's water resources may be based. The need for water resources information is especially great in urbanized areas, where concern is being expressed that the 'carrying' capacity of the land and water resources is being exceeded. Increasingly intensive and sophisticated water management programs will have to be implemented in these urban areas to meet the increased needs for water and to maintain good water quality. Water data and information required to implement sound water management programs in highly urbanized areas relate to the quantity and quality of stormwater runoff, sources of aquifer contamination, injection of wastes into deep strata, underground storage of freshwater, artificial recharge of aquifers, environmental effects of reuse of water, and effects of land development on changes in groundwater and surface water quality. In some parts of the State broad areas are largely rural. Future growth is anticipated in many of these. However, recognition is given to the need for planned development tailored to the environment. The need for water information in these rural areas is related to the need to provide for primary water development and to provide information on effects of development. (USGS)
W91-11928

METHOD TO ESTIMATE CANAL LEAKAGE TO THE BISCAYNE AQUIFER, DADE COUNTY, FLORIDA.
Geological Survey, Miami, FL. Water Resources Div.
D. A. Chin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4135, 1990. 32p, 21 fig, 3 tab, 36 ref.

Descriptors: *Aquifer characteristics, *Canals, *Leakage, *Model studies, *Surface-groundwater relations, Acoustics, Drawdown, Model testing, Open channels, Transmissivity, Velocity distribution.

Leakage characteristics of channels that partially penetrate the Biscayne aquifer and have reduced bed permeability were studied. Characteristics were described in terms of reach transmissivity--the volume flow rate out of the channel per unit length of the channel per unit drawdown, where drawdown is the difference in altitude between the water surface in the canal and the water table in the adjacent aquifer. A theoretical expression was developed to relate the reach transmissivity to the transmissivity of the formation, mean channel width, distance of drawdown measurement from the channel centerline, ratio of drawdowns on both sides of the channel, and local reach transmissivity associated with reduced bed permeability. This expression was verified using a fine-scale numerical model, which gave accurate results when drawdowns were measured beyond 10 aquifer depths from the side of the channel. The theoretical reach transmissivity function was compared with field measurements at two canals in Dade County, Florida. At L-31N Canal, measurements indicated that the local reach transmissivity was relatively uniform over a 2-mile reach of the channel, averaging 630 cu ft/s/mi/ft, and the formation transmissivity was 0.0000018 sqft/d. At Snapper Creek Extension Canal, an approximate analysis was necessary due to the inability of the acoustic velocity meter to measure very low water velocities in the channel. Assuming an aquifer transmissivity of 0.000001 sq ft/d, drawdown measurements indicated that the local reach transmissivity was about 400 cu ft/s/mi/ft. The theoretical relation, combined with the local reach and formation transmissivities, was sufficient to predict leakage out of the canals for any drawdown scenario. (USGS)
W91-11934

HYDROLOGIC DATA FOR THE WELDON SPRING CHEMICAL PLANT SITE AND VICINITY PROPERTY, ST. CHARLES COUNTY, MISSOURI--1986-89.
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11950

ENVIRONMENTAL IMPACTS OF CHANNELIZATION ON THE RIVER MAIN, COUNTRY ANTRIM, NORTHERN IRELAND.
Ulster Univ., Coleraine (Northern Ireland). Dept. of Environmental Studies.
For primary bibliographic entry see Field 6G.
W91-11972

SEDIMENT CONCENTRATION OF INTERRILL RUNOFF UNDER VARYING SOIL, GROUND COVER, SOIL COMPACTION, AND FREEZING REGIMES.
Agriculture Canada, Charlottetown (Prince Edward Island). Research Station.
For primary bibliographic entry see Field 2J.
W91-11999

BASEFLOW AND STORMFLOW TRANSPORT OF NUTRIENTS FROM MIXED AGRICULTURAL WATERSHEDS.
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
For primary bibliographic entry see Field 5B.
W91-12000

AQUATIC HYPHOMYCETE COMMUNITIES IN THE RIVER TEIGN: IV. TWIG COLONIZATION.
Illinois Univ., Urbana. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-12040

HYDROLOGIC CHANNEL-FLOW ROUTING FOR COMPOUND SECTIONS.
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
J. Garbrecht, and G. Brunner.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 629-642, May 1991. 4 fig, 2 tab, 27 ref.

Descriptors: *Channel flow, *Flow characteristics, *Flow models, *Model studies, *Routing, Drainage patterns, Flow, Hydrograph analysis, Hydrographs, Mathematical models, Mixing, Overbank flow, Rainfall, Runoff, Simulation, Storage.

An efficient channel-flow routing scheme for large drainage networks with compound sections and for continuous long-term simulation is often needed for sediment and water quality investigations. A Muskingum-Cunge channel-flow routing scheme was adopted for this purpose. Main channel and overbank flow in compound cross sections were decoupled and routed separately to quantify the different flow characteristics in each channel portion. A variable time step was introduced to increase the efficiency of the numerical scheme. Flow mixing between main channel and overbank flow takes place at the end of each computational space increment. A variable time step was introduced for an efficient long-term simulation. Large time increments are used during interstorm periods, and shorter time increments apply when discharge varies during rainfall-runoff events. The adaptations of the channel routing scheme were tested against hydraulic channel-flow routing using the DAMBRK model. Test conditions consisted of several hypothetical flood hydrographs in long prismatic channels with significant overbank storage. For the tested cases, hydrograph peak and time to peak were, on the average, within 4% of the results from hydraulic routing. Simulated hydrograph shapes were consistent with expectations, and hydrograph distortions, resulting from overbank flood plains, were well reproduced. Execution of the numerical scheme was generally more than one order of magnitude faster than the benchmark hydraulic routing. (Author's abstract)
W91-12055

DYE-CONCENTRATION DISTRIBUTION IN SHALLOW RECIRCULATING FLOWS.
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
S. Babarutsi, and V. H. Chu.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 643-659, May 1991. 16 fig, 1 tab, 18 ref.

Descriptors: *Channel morphology, *Dyes, *Friction, *Hydraulics, *Open-channel flow, *Recirculating flow, *Shallow water, *Tracers, Calibrations, Channels, Mixing, Shear, Turbulent flow.

Mixing in shallow open-channel flows is intimately related to bed friction, which generates small-scale turbulence and, at the same time, reduces the effectiveness of the transverse shear to produce large-scale turbulence. A study was undertaken to collect concentration data in recirculating flows that are under strong bed-friction influence. Dye concentration measurements were conducted in the recirculating region of a sudden open-channel flow expansion, where the water depth is shallow compared to the horizontal length scale of the channel expansion. The turbulent motion is anisotropic, and is subjected to a stabilizing bed-friction influence, in the confinement between the free surface and the channel bed. Two opposing mechanisms affect the transverse mixing processes in the shallow recirculating flow. On the one hand, the transverse mixing is reduced by the stabilizing bed friction effect. On the other hand, it is enhanced by a confinement effect, which becomes effective when the width-to-depth ratio of the channel expansion exceeds a value of about 9-12. These opposing influences are equally significant in the range of the bed friction number from 0.08-0.10. The concentration data of the investigation are complementary to the published velocity data obtained in the same recirculating flows. Both sets of data are useful for model calibration of shallow open-channel flows. (Doria-PTT)
W91-12056

ESTIMATING FLOW THROUGH RIPRAP.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
S. R. Abt, J. F. Ruff, and R. J. Wittler.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 670-675, May 1991. 2 fig, 2 tab, 11 ref.

Descriptors: *Flow velocity, *Hydraulic engineering, *Riprap, Embankments, Estimating equations, Flood control, Flow measurement, Flumes, Hydraulic structures, Rock fill, Rock properties, Turbulent flow.

Estimating flow through rockfill is useful for designing or evaluating flood control, waste repository, and waterways structures. Through-flow velocity is defined as the average velocity of water flow through rock voids. An understanding of turbulent flow in a rock medium is needed for through-flow analyses. The average interstitial, or through-flow, velocity is a function of the riprap properties and the gradient. However, in the preliminary design process, the engineer must assume a representative stone size and gradation before extensive material testing or analysis of a rock source is done. Therefore, a method is presented to

predict average through-flow velocity for riprap and rockfill. A series of 19 flume tests was conducted, in which flow was routed through a riprap layer, and an average interstitial, or through-flow, velocity was measured. Flow measurements varied plus or minus 40% about the average velocity. A predictive relationship was developed in which the average interstitial velocity was determined to be a function of the embankment slope and rock size D10 (the stone diameter at which 10% of the weight is finer). The predictive relationship provides the designer with a method for estimating through-flow based upon a representative stone size, gradation, and embankment slope. The relationship was developed for stone sizes with a D50 ranging from 2.6 to 15.7 cm, and D10 ranging from 1.5 to 9.7 cm. (Doria-PTT)
W91-12058

INFLUENCE OF GEOMETRY ON DISCHARGE CAPACITY OF OPEN CHANNELS.
Ulster Univ., Coleraine (Northern Ireland). Dept. of Civil Engineering.
W. R. C. Myers.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 676-670, May 1991. 3 fig, 1 tab, 5 ref.

Descriptors: *Channel morphology, *Discharge capacity, *Flow discharge, *Open-channel flow, Flow measurement, Friction, Slopes, Streamflow, Venturi meters.

Among the factors that influence the discharge capacity of open channels and rivers, cross-sectional geometry has long been recognized as important. However, no systematic investigation of its effect on channel capacity has been carried out, largely because of the many variations involved. Experiments were carried out using a tiltable recirculating water channel 9 m long of varying widths. Discharge was measured volumetrically at low flows and by means of a venturi meter connected to a mercury manometer at high flows. A wide range of longitudinal bed slopes was considered. The cross-sectional shape of an open channel was found to influence its discharge capacity because of the occurrence of secondary circulation. A wide rectangular section carries as much as 80% less than a narrow channel, and as much as 25% less than a compound section of the overall width, at the same cross-sectional area in each case. Friction factors in wide rectangular sections are as much as 45% greater than narrow sections, and as much as 25% greater than friction factors in compound sections of the same overall width, at the same cross-sectional area in each case. These findings show the dangers of neglecting shape effects in open channels and underline the need for a systematic investigation of the influence of cross-sectional shape on discharge capacity of open channels. (Doria-PTT)
W91-12059

EFFECT OF MAXIMUM RAINFALL POSITION ON RAINFALL-RUNOFF RELATIONSHIP.
Moncton Univ. (New Brunswick). School of Engineering.
N. El-Jabi, and S. Sarraf.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 681-685, May 1991. 4 fig, 1 tab, 4 ref.

Descriptors: *Hydrograph analysis, *Hyetographs, *Rainfall intensity, *Rainfall-runoff relationships, *Storm runoff, *Storm water, *Urban hydrology, *Urban runoff, Canada, Design criteria, Moncton, Optimization, Precipitation, Storm sewers, Storms.

The treatment of sanitary and storm waters necessitates an optimal design for the main interceptor sewer system. The majority of design methods for wastewater collection systems, most of which concern storm water, use different approaches derived from the rational equation which is useful for the estimation of the maximum runoff discharge of a real or a synthetic hyetograph. Synthetic hyetographs are developed using intensity-duration-frequency (IDF) curves. They represent a descriptive model of a rainfall in which the time duration is equal to or less than the concentration time of the basin under study. These hyetographs preserve the average intensity of precipitation and do not produce any rise in the storm volume. Based on these synthetic hyetographs, it is possible to construct runoff hydrographs, e.g., by using a simulation model or a unit hydrograph. Synthetic hyetographs have one common property: the fixed location of maximum precipitation in relation to the duration of rainfall. Thus, as an example for Montreal, the location of the maximum intensity of precipitation is taken in the middle of the rainfall regardless of its duration, while for Chicago, it is taken at about 35.5% of the rainfall duration. The development of synthetic hyetographs for Moncton, Canada, has required consideration of variable positions of the maximum intensity of precipitation in relation to the duration of rainfall. The effect of this variability was examined. The choice of a constant value of r (ratio of the time to the peak of the hyetograph, to the rainfall duration) was found to make it easier to apply the method of synthetic hyetographs. However, in certain cases the optimization of a storm sewer network requires a variable value of r in time. The application of this approach in the Moncton area resulted in two hydrographs with practically the same peak at discharge, but displaced in time. (Doria-PTT)
W91-12060

HYDROBIOLOGICAL STATE OF THE RIVER VALLEY OF THE RIVER LOM.
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
B. K. Rusev, I. J. Janeva, and M. I. Nikolova.
Khidrobiologiia KHIDD9, Vol. 36, p 13-31, January 1991. 2 fig, 4 tab, 5 ref. (English summary).

Descriptors: *Benthos, *Bulgaria, *Danube River, *Hydrobiology, *Invertebrates, *Midges, *Oligochaetes, *Water pollution sources, *Water quality, Caddisflies, Industrial wastes, Rivers, Species composition, Species diversity, Stream biota, Stream pollution, Water chemistry, Water pollution.

Results from the hydrobiological, hydrochemical and saprobiological studies carried out along the right Danubian tributary, the river Lom, and its feeders (Stakevska, Cuprenska and Necinska Bara) during various seasons of 1973, 1974, and 1986 as well as hydrofaunistical samples collected at single stations at the river Lom in the 1961-1978 period are presented. A total of 249 taxa from the species of benthos invertebrates was established; 201 of them were found in the river Lom, 112 in the Stakevska, 106 in the Cuprenska, and 65 in the Necinska Bara rivers. The river Lom had the greatest amount of larvae (74) from the species of the family Chironomidae (order Diptera), followed by those of order Ephemeroptera (40, order Trichoptera (35), class Oligochaeta (25), and order Plecoptera (17). The frequency of occurrence, the frequency of domination and the order of domination of the species have been calculated. The saprobiological results and the hydrochemical indexes point to the comparatively good state of the zoocoenoses and in general of the rivers Stakevska, Cuprenska, and Necinska Bara, and of the river Lom near the town of Lom. Throughout the study period the rivers were in a xenosaprobic and oligosaprobic state in their upper streams, while downstream they passed into a beta-mesosaprobic state. Only the river Lom near the town of Lom and near its mouth at the Danube is polluted to a state of alpha-mesosaproby, polysaproby, respectively, due to the wastewaters of the industrial area. However, the small water amount of the river Lom (about 5.20 cu m/sec near the village of Drenovec) cannot considerably influence the Danube whose water amount is significantly larger (annual average about 6000 cu m/sec). (Author's abstract)
W91-12064

STOCHASTIC STUDY OF FLOODS IN CANADA: FREQUENCY ANALYSIS AND REGIONALIZATION.
Department of Fisheries and Oceans, Moncton (New Brunswick). Science Branch.
D. Caissie, and N. El-Jabi.
Canadian Journal of Civil Engineering CJCEB8, Vol. 18, No. 2, p 225-236, April 1991. 6 fig, 7 tab, 35 ref. Natural Sciences and Engineering Research Council of Canada Grant G1617.

Descriptors: *Canada, *Flood forecasting, *Flood frequency, *Model studies, *Peak discharge, *Regional analysis, Flood peak, Frequency analysis, Hydrologic models, Mathematical models, Risk assessment, Stochastic process, Streamflow forecasting.

Peak stream discharge is a very important hydrologic parameter in the determination of flood risk, design of engineering works, and management of water resources. Some 237 records from across Canada were analyzed using the theory of stochastic processes applied to extreme values. The model, based on partial duration series analysis, was applied to each stream record, considering the time of occurrence of floods to be a Poisson process. Also, exceedances (values above a given discharge level or truncation level) were considered to be independent random variables identically distributed over a 1-yr time interval. After this frequency analysis of each stream record, a regionalization of the flood frequency characteristics in Canada was performed using two different approaches: (1) multiple regression analysis and (2) index-floor method. The two approaches were compared by examining mean relative error and root-mean-square error. It was determined that the level of difficulty in applying the stochastic flood model was not the same across Canada. Moreover, error associated with the index-flood method mainly was due to error in estimating low return flows. (Author's abstract)
W91-12083

MULTI-DAY FLOW FORECASTING USING THE KALMAN FILTER.
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
M. A. Fitch, and E. A. McBean.
Canadian Journal of Civil Engineering CJCEB8, Vol. 18, No. 2, p 320-327, April 1991. 9 fig, 5 tab, 24 ref, append.

Descriptors: *Flow models, *Model studies, *River forecasting, *Runoff, *Streamflow forecasting, Algorithms, Hydrologic models, Kalman filtering, Mathematical models, Ontario, Precipitation, Snowmelt, Statistics, Sturgeon River.

Developing accurate river flow forecasts is particularly difficult when river flow is the combination of both the dissipation in the spring of winter snowpack and the incidence of precipitation on the melting snowpack. An additional complication arises for remote locations because there often is a lack of data. A model was developed for the prediction of river flows resulting from combined snowmelt and precipitation. The model employs the Kalman filter to reflect uncertainty both in the measured data and in the system model parameters. The forecasting algorithm was used to develop multi-day forecasts for the Sturgeon River, Ontario. The algorithm develops good 1 day-ahead and 2 day-ahead forecasts, but the linear prediction model is inadequate for longer-term forecasts. Good initial parameter estimates were shown to be essential for optimal forecasting performance. (Author's abstract)
W91-12088

STOCHASTIC STUDY OF FLOODS IN CANADA: TRUNCATION LEVEL BY REGION.
Department of Fisheries and Oceans, Moncton (New Brunswick). Science Branch.
D. Caissie, and N. El-Jabi.
Canadian Journal of Civil Engineering CJCEB8, Vol. 18, No. 2, p 328-330, April 1991. 1 fig, 1 tab, 14 ref. Natural Sciences and Engineering Research Council of Canada Grant G1617.

Descriptors: *Canada, *Flood forecasting, *Flood frequency, *Model studies, *Regional analysis, *Regression analysis, *Stochastic process, Annual floods, Frequency distribution, Mathematical equations, Partial duration series, Truncation level.

The main problem in applying a partial duration series model in flood frequency analysis lies in the selection of the truncation level. From a practical point of view it is important to have a simple and effective way of selecting this level. A truncation level study was conducted on hydrometric stations across Canada and regional equations were developed for estimating the truncation level using regression analysis. The homogeneous region was selected based on previous countrywide hydrological studies. From the hydrologic and physiographic parameters used in the regression analysis, the mean annual flood best explained the truncation level for all the regions. (Author's abstract)
W91-12089

PORTABLE CHAMBER FOR MEASURING ALGAL PRIMARY PRODUCTION IN STREAMS.
Colgate Univ., Hamilton, NY. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W91-12094

MESH-SIZE EFFECTS ON DRIFT SAMPLE COMPOSITION AS DETERMINED WITH A TRIPLE NET SAMPLER.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W91-12096

SALINITY TOLERANCES OF FOUR SPECIES OF FISH FROM THE MURRAY-DARLING RIVER SYSTEM.
Adelaide Univ. (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-12105

PREDICTION OF WATER TEMPERATURES IN CHALK STREAMS FROM AIR TEMPERATURES.
Institute of Freshwater Ecology, Wareham (England). River Lab.
For primary bibliographic entry see Field 2H.
W91-12108

EFFECTS OF SPATES ON INTERSTITIAL ASSEMBLAGES OF THE RHONE RIVER: IMPORTANCE OF SPATIAL HETEROGENEITY.
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
P. Marmonier, and M. Creuze des Chatelliers.
Hydrobiologia HYDRB8, Vol. 210, No. 3, p 243-251, March 1991. 2 fig, 5 tab, 36 ref.

Descriptors: *Ecology, *France, *Rhone River, *Surface-groundwater relations, *Water level fluctuations, Drought, Floods, Interstitial water, Invertebrates, Miribel Canal, Streamflow.

Rapid variation in discharge, such as spates and droughts, are among the more typical disturbances observed in unpolluted temperate streams. The dynamics of interstitial invertebrate assemblages after a spate and during low discharge were studied in the Miribel Canal, a regulated channel of the Upper Rhone River, France. Using a Bou-Rouch pump, three stations were sampled: (1) a site fed by superficial water infiltration, (2) a site fed by riparian phreatic water, and (3) a site fed by both surface and phreatic waters. The spate greatly influenced the interstitial assemblages and their dynamics varied according to the hydrology of each site. At station 1, the spate had a washout effect on the assemblages (reduction in abundance and diversity), whereas during low discharge the interstitial layer received a continuous influx of epigean organisms (benthic and limnophilous). At stations 2 and 3, the spate introduced numerous limnophilous and benthic invertebrates into the interstices, which function as an organismic trap. However, these sites appear to be more isolated from surface waters during low discharge. Stygobites decreased or disappeared after the spate. They appear to be highly sensitive to hydrologic perturbations in the surface waters. (Author's abstract)
W91-12111

RESPONSE OF A STREAM IN DISEQUILIBRIUM TO TIMBER HARVEST.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 4C.
W91-12118

TRICHOPTERA AND SUBSTRATE STABILITY IN THE OCHRE RIVER, MANITOBA.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 6G.
W91-12123

VARIATION IN NUTRIENT LIMITATION OF LOTIC AND LENTIC ALGAL COMMUNITIES IN A TEXAS (USA) RIVER.
Southwest Texas State Univ., San Marcos. Aquatic Station.
E. H. Stanley, R. A. Short, J. W. Harrison, R. Hall, and R. C. Wiedenfeld.
Hydrobiologia HYDRB8, Vol. 206, No. 1, p 61-71, October 15, 1990. 4 fig, 3 tab, 35 ref.

Descriptors: *Algae, *Guadalupe River, *Limiting nutrients, *Phytoplankton, *Stream biota, Biomass, Chlorophyll, Nitrogen, Nutrients, Periphyton, Phosphorus, Population dynamics, Texas, Water level fluctuations.

Nutrient-diffusion substrates with added nitrogen (N) and phosphorus (P) were used to identify the limiting nutrient for lotic algae at three Upper Guadalupe (Texas) river sites in summer, fall, and winter. Pots enriched with P had significantly higher chlorophyll a concentrations for 7 of 9 trials. Added N alone did not significantly increase algal standing crops, although it was found to be secondarily limiting on one and possibly two occasions. Flow-through enrichment experiments were conducted in order to quantify the concentration of P needed to significantly increase algal standing crops. Response to enrichment was rapid when ambient P concentration was low (<0.010 mg/L), but more moderate when ambient P levels were higher (0.015-0.025 mg/L). Nutrient limitation of phytoplankton in small surface-release reservoirs varied throughout the study, but N was either primarily or secondarily limiting in 6 of 8 trials; shifts in the limiting nutrient were correlated with fluctuations in flow into the reservoirs. These enrichment studies show that algal response to nutrient addition was unpredictable because phytoplankton tend to be N-limited while periphyton are mainly P-limited. Further, while discharge apparently dictated the nutrient-biomass relationship for phytoplankton in reservoirs, ambient nutrient level was an important determinant of lotic periphyton response to enrichment. (Author's abstract)
W91-12125

SPATIAL VARIATION IN BASIC CHEMISTRY OF STREAMS DRAINING A VOLCANIC LANDSCAPE ON COSTA RICA'S CARIBBEAN SLOPE.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
C. M. Pringle, F. J. Triska, and G. Browder.
Hydrobiologia HYDRB8, Vol. 206, No. 1, p 73-85, October 15, 1990. 5 fig, 3 tab, 45 ref. NSF Grant BSR-87-17746.

Descriptors: *Costa Rica, *Environmental chemistry, *Phosphorus, *Spatial distribution, *Streams, *Water chemistry, *Weathering, Dissolved solids, Forest watersheds, Geochemistry, Minerals, Mountain lakes, Mountain watersheds, Rain forests, Surface-groundwater relations, Volcanic streams, Water quality.

Spatial variability in selected chemical, physical and biological parameters was examined in waters draining relatively pristine tropical forests spanning elevations from 35 to 2600 meters above sea level in a volcanic landscape on Costa Rica's Caribbean slope. Waters were sampled within three different vegetative life zones and two transition zones. Water temperatures ranged from 24-25 C in streams draining lower elevations (35-250 m) in tropical wet forests, to 10 C in a crater lake at 2500 m in montane forests. Ambient phosphorus levels (60-300 micrograms soluble reactive phosphorus (SRP)/L; 66-405 TP/L) were high at sites within six pristine drainages at elevations between 35-350 m, while other undisturbed streams within and above this range in elevation were low (typically <30.0 micrograms SRP/L). High ambient phosphorus levels within a given stream were not diagnostic of riparian swamp forest. Phosphorus levels (but no nitrate) were highly correlated with conductivity, Cl, Na, Ca, Mg, and SO4. Results indicate two major stream types: (1) phosphorus-poor streams characterized by low levels of dissolved solids reflecting local weathering processes; and (2) phosphorus-rich streams characterized by relatively high Cl, SO4, Na, Mg, Ca and other dissolved solids, reflecting dissolution of basaltic rock at distant sources and/or input of volcanic brines. Phosphorus-poor streams were located within the entire elevation range, while phosphorus-rich streams were predominately located at the terminus of Pleistocene lava flows at low elevations. Results indicate that deep groundwater inputs, rich in phosphorus and other dissolved solids, surface from basaltic aquifers at breaks in landform along faults and/or where the foothills of the central mountain range merge with the coastal plain. (Author's abstract)
W91-12126

TEMPORAL VARIATIONS IN THE TRACE ELEMENT CONTENT OF STREAM SEDIMENTS: AN EXAMPLE FROM A TROPICAL RAIN FOREST REGIME, SOLOMON ISLANDS.
British Geological Survey, Keyworth (England).
For primary bibliographic entry see Field 2K.
W91-12132

STREAM HABITAT ASSESSMENT PROGRAMS IN STATES OF THE AFS NORTH CENTRAL DIVISION.
Meyer (W.E.), State College, PA.
For primary bibliographic entry see Field 6B.
W91-12174

DYNAMICS OF PARTICULATE MATTER NEAR THE MOUTH OF INFLUX RIVER IN TAKAHAMAIRI BAY OF LAKE KASUMIGAURA, WITH SPECIAL REFERENCE TO NITROGEN AND PHOSPHORUS.
National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 2H.
W91-12176

TRANSPORT AND RETENTION OF PARTICULATE ORGANIC MATTER IN TWO LOW-GRADIENT HEADWATER STREAMS.
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
For primary bibliographic entry see Field 2J.
W91-12179

INFLUENCE OF NUTRIENTS AND GRAZING ON THE RESPONSE OF STREAM PERIPHYTON COMMUNITIES TO A SCOUR DISTURBANCE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
P. J. Mulholland, A. D. Steinman, A. V. Palumbo, and D. L. DeAngelis.
Journal of the North American Benthological Society JNASEC, Vol. 10, No. 2, p 127-142, June 1991. 5 fig, 4 tab, 39 ref. NSF Interagency Agreement No. 40-689-78, and DOE Contract No. DE-AC05-84OR21400.

Descriptors: *Ecosystems, *Nutrients, *Periphyton, *Scour, *Stream ecology, Biomass, Flow pattern, Resilience, Snails, Streamflow.

Nutrient input and grazing intensity were examined with respect to resistance and resilience of periphyton communities in laboratory streams to a scour disturbance. Previous theoretical studies using stream models indicated that resilience of

nutrient-limited streams, as defined by the return time to the initial state, is strongly related to the residence time of nutrients in the system and to the presence of herbivores. To experimentally test this prediction two levels of nutrient input were established by altering the flow regime (once-through flow and 98% recirculated flow) and two levels of grazing intensity by the presence or absence of the snail Elimia clavaeformis, resulting in a 2 X 2 factorial design with two replicate streams per treatment. After the streams reached an approximately stable level of periphyton biomass, a scour disturbance was imposed on all streams. Measures of the resistance and resilience of the periphyton to this disturbance were made. The resistance of most structural characteristics of the periphyton was significantly higher in streams with snails than in streams without snails. Nutrient input had little effect on resistance of all periphyton characteristics. Resilience was measured by two parameters: rate of increase of a particular characteristic over time following the disturbance (r), and time to return to the predisturbance state (Ts). The experimental results on resilience were complex. In general, high grazing intensity resulted in low values of r for most periphyton characteristics, but also shorter Ts for some characteristics. The shorter Ts values were attributed to lower pre-disturbance biomass and metabolism in the streams with snails compensating for lower r for these characteristics following the disturbance. Contrary to model predictions, low nutrient input generally did not result in low resilience for most characteristics in the streams without snails, probably because increased nutrient recycling compensated for low inputs. However, for the streams with snails, resilience of most periphyton characteristics was lower in streams with low nutrient input compared with streams with higher nutrient input. (Author's abstract)
W91-12180

EFFECTS OF DISTURBANCE ON STREAM MOSS AND INVERTEBRATE COMMUNITY STRUCTURE.
Umea Univ. (Sweden). Dept. of Animal Ecology.
G. Englund.
Journal of the North American Benthological Society JNASEC, Vol. 10, No. 2, p 143-153, June 1991. 4 fig, 3 tab, 41 ref.

Descriptors: *Ecosystems, *Invertebrates, *Mosses, *Stream ecology, *Streams, Population dynamics, Scour, Species composition, Streambeds, Sweden.

Natural occurrence of overturned stones and the distribution of moss with respect to stone size and stability were examined in two North Swedish woodland streams. In total, 16.7% of moss-covered stones had obviously been overturned in the last few years. Moss was rare on small stones except for those that were embedded in the surrounding substrate. On large stones (> 12 cm), moss was abundant and embedment did not affect the moss distribution here. It is concluded that the stability of substrates markedly affected the distribution of stream moss. In a field experiment, moss-covered stones were overturned to simulate mild spate effects, and the recovery of moss and invertebrates was followed for 14 mo. The treatment reduced ash free dry weight of moss as well as diversity (H') and total abundance of invertebrates. Three out of 16 invertebrate taxa increased their density as a result of disturbance, showing peak densities on the moss-covered underside of overturned stones. All other taxa decreased their density upon overturning, and in these taxa peak densities were found on the moss-covered upper side of control stones. Recovery of moss and invertebrates was still weak 14 mo after the stone overturning. It was concluded that overturning of stones has severe and prolonged effects on stream moss and, indirectly, on the benthic invertebrate community. (Author's abstract)
W91-12181

RAPID GROWTH OF SNAG-DWELLING CHIRONOMIDS IN A BLACKWATER RIVER: THE INFLUENCE OF TEMPERATURE AND DISCHARGE.
Alabama Univ. in Birmingham. Dept. of Biology.
F. R. Hauer, and A. C. Benke.
Journal of the North American Benthological Society JNASEC, Vol. 10, No. 2, p 154-164, June 1991. 3 fig, 3 tab, 36 ref. NSF Grant Nos. BSR-8408188 and BSR-8406630.

Descriptors: *Blackwater streams, *Chironomids, *Flow discharge, *Ogeechee River, *Population dynamics, *Stream ecology, *Water temperature, Biomass, Coastal plains, Ecosystems, Georgia, Invertebrates, Mathematical studies, Seasonal variation.

Growth rates were measured for chironomid larvae throughout the year in chambers simulating natural conditions at a field site on the bank of the Ogeechee River, a blackwater river in the Georgia Coastal Plain. Growth rates were among the highest ever reported for chironomids in laboratory or field studies, averaging 0.60, 0.43, and 0.44 mg/mg/d for Chironomini, Tanytarsini, and Orthocladiinae, respectively. The relationship of growth with temperature was best described with second-order polynomial curves for Chironomini, Tanytarsini, and total Chironomidae. Most curves suggest an x-axis intercept (zero growth) at 4-7 C and a growth maximum at 21-24 C. Growth rates were significantly lower and the relationship of growth with temperature was no longer significant when river discharge was well below the mean. Growth equations were applied to natural environmental conditions, predicting maximum growth during spring and fall, with an annual growth rate (an approximation of annual P/B ratio) ranging from 222 for Chironomini to 182 for Tanytarsini. Predicted growth rates were high throughout all seasons, indicating that the bioenergetic role of chironomids in invertebrate communities is substantially greater than can be assumed based on their standing stock biomass alone. (Author's abstract)
W91-12182

DISTRIBUTION AND STABILITY OF POTENTIAL SALMONID SPAWNING GRAVELS IN STEEP BOULDER-BED STREAMS OF THE EASTERN SIERRA NEVADA.
California Univ., Berkeley. Dept. of Landscape Architecture.
G. M. Kondolf, C. F. Cada, M. J. Sale, and T. Felando.
Transactions of the American Fisheries Society TAFSAI, Vol. 120, No. 2, p 177-186, March 1991. 5 fig, 2 tab, 23 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Gravel, *Nevada, *Spawning, *Streambeds, Distribution patterns, Geomorphology, Scour, Seasonal variation, Snowmelt, Stream fisheries, Trout.

High-gradient boulder-bed streams have been the sites of relatively few studies of salmonid spawning habitat, although they have geomorphic and hydraulic characteristics--and therefore gravel distributions--that are quite different from the more commonly described lower gradient channels. Gravel distribution was documented in seven high-gradient stream reaches in the eastern Sierra Nevada. Gravels occurred only in locations characterized by relatively low shear stress; they formed small pockets in sites of flow divergence and larger deposits upstream of natural hydraulic controls. In 11986 (a wet year), all tracer gravels placed in gravel pockets at nine sites on four streams were completely swept away, and substantial scour, fill, and other channel changes occurred at many sites. In 1987 (a dry year), tracer gravels and the channel cross sections were generally stable. Periodic mobility of gravel may explain why brown trout are more abundant than rainbow trout in the study reaches, where high flows occur every May and June during snowmelt. Brown trout are fall spawners, and their fry emerge long before the high snowmelt flows, whereas rainbow trout are spring spawners whose eggs are in the gravel, and thus vulnerable to scour, during snowmelt flows. (Author's abstract)
W91-12183

EUCALYPT LEAF DECOMPOSITION IN AN INTERMITTENT STREAM IN SOUTH-EASTERN AUSTRALIA.
Monash Univ., Clayton (Australia). Dept. of Botany.
A. J. Boulton.
Hydrobiologia HYDRB8, Vol. 211, No. 2, p 123-136, March 22, 1991. 6 fig, 7 tab, 84 ref.

Descriptors: *Australia, *Decomposition, *Eucalyptus trees, *Intermittent streams, *Leaves, Adenosine triphosphate, Aquatic bacteria, Detritus, Ecology, Food habits, Invertebrates, Lerderberg River.

Microbial enrichment of terrestrially-exposed leaf material in a temporary vernal pool was first demonstrated in western Ontario in the 1970s. When decaying detritus is exposed to air during the waterless period, its protein content becomes greater than that of detritus in nearby permanent pools. Eucalypt leaf packs were placed at two sites in an intermittent stream (Lerderberg River, Victoria, Australia) during summer to examine the hypothesis that terrestrially-exposed litter accumulates a richer microbial flora than submerged leaves. This did not occur. During the experiment microbial biomass (as ATP) rose steadily on submerged leaves but remained low on terrestrially-exposed leaves. Densities of most functional feeding groups on the submerged leaves increased with time. Scrapers appeared to be more important than shredders in eucalypt leaf breakdown at both sites. (Author's abstract)
W91-12190

TRANSPORT OF COARSE PARTICULATE ORGANIC MATTER IN AN IDAHO RIVER, USA.
Idaho State Univ., Pocatello. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2J.
W91-12192

EFFICACY OF SWMM APPLICATION.
Texas Univ. at Dallas, Richardson. Inst. for Environmental Sciences.
For primary bibliographic entry see Field 4A.
W91-12206

OUTPUT RELIABILITY AS GUIDE FOR SELECTION OF RAINFALL-RUNOFF MODELS.
Rutgers - The State Univ., Piscataway, NJ. Dept. of Civil and Environmental Engineering.
C. S. Melching, B. C . Yen, and H. G. Wenzel.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 117, No. 3, p 383-398, May/June 1991. 6 fig, 4 tab, 20 ref. USGS Grant INT-14-08-0001-G1223.

Descriptors: *Flood peak, *Mathematical models, *Model studies, *Rainfall-runoff relationships, *Reliability, Advanced first-order second-moment relia, Decision making, Floods, Illinois, Performance evaluation, Simulation, Vermilion River.

Selection of rainfall-runoff models depends on the modeling objectives and the simulation accuracy required. Output reliability is proposed as a measure to help in choosing the appropriate model for a given rainfall-runoff model. Output reliability can be expressed by the output variable cumulative distribution function, probability density function, confidence limits, standard deviation, or probability of acceptable percent deviation from the predicted value. Approximations of these reliability measures can be established by methods such as advanced first-order, second-moment (AFOSM) reliability analysis. To demonstrate this approach, peak discharge was estimated for a watershed in central Illinois (Vermilion River, Pontiac). Both the nonlinear, quasi-distributed runoff routing (version B) (RORB) program and a linear, lumped-system option of HEC-1 were used. The application of the AFOSM reliability analysis method to the uncertainties in the RORB and HEC-1 modeling schemes showed that these model produce predictions of near equal reliability, especially on a decision-making level. The actual use of these models for peak discharge estimation for a catch-

ment depends further on the output reliability that is acceptable to the model user. (Rochester-PTT)
W91-12208

KINEMATIC ROUTING USING FINITE ELEMENTS ON A TRIANGULAR IRREGULAR NETWORK.
Agricultural Research Service, Tucson, AZ. Arid-land Watershed Management Research Unit.
D. C. Goodrich, D. A. Woolhiser, and T. O. Keefer.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 995-1003, June 1991. 7 fig, 1 tab, 46 ref.

Descriptors: *Digital map data, *Flow models, *Mapping, *Model studies, *Rainfall-runoff relationships, *Routing, *Runoff, *Surface flow, Excess rainfall, Finite element method, Hydrographs, Mathematical studies, Small watersheds.

Automated extraction of geometry for hydraulic routing from digital elevation models (DEM) is a procedure that must be easily accomplished for widespread application of distributed hydraulically based rainfall excess-runoff models. One-dimensional kinematic routing on a regular grid DEM is difficult due to flow division and convergence. Two-dimensional kinematic routing on a triangular network (TIN) surmounts many of these difficulties. The local TIN finite element routing strategy was tested to illustrate the viability of the method for kinematic routing of excess rainfall on small catchments. The technique capitalizes on the coordinate random, surface specific efficiency of a triangular irregular network of digital elevation data to represent topography. Each topographic triangle (TIN facet) is subdivided into a set of coplanar triangular finite elements, and routing is performed on a single facet and then the resulting excess hydrograph is routed to downstream channels via upstream boundary conditions. Quadrisection of individual TIN facets and local coordinate rotation orthogonal to the surface gradient permits ease of application by providing a small system of simultaneous equations for solution. Results indicate that shock conditions are readily handled, computed depths match analytic results to within +/-3% and volume balances are typically within 1%. Facet by facet routing also allows ready incorporation of one-dimensional, finite difference, channel routing. This modeling system illustrates the viability of kinematic routing over a TIN DEM derived directly from digital mapping data. (Author's abstract)
W91-12215

INFORMATION TRANSFER WITH CENSORED DATA: SOME LARGE-SAMPLE RESULTS.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
R. T. Clarke.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1011-1018, June 1991. 4 tab, 16 ref.

Descriptors: *Data analysis, *Flood data, *Flood forecasting, *Information transfer, *Model studies, *Statistics, Censored data, Flood frequency, Flood peak, Hydrologic models, Mathematical analysis, Probabilistic process.

Methods for transfer and extension of annual flood data at sites with short hydrological records utilized incomplete or 'censored' data, such as may be supplied by people living near a river or from records collected for non-hydrological purposes. For two specific censoring configurations, the gain in information is assessed analytically; it is shown that, under certain conditions, the gain in information can be substantial, but in general the gain is small, particularly where scale parameters are estimated. For other configurations of censored data, an analytical formulation is not possible, and integrals are given from which information gain may be assessed by numerical calculation. Another result extends the use of flood peaks exceeding some threshold value ('peaks over a threshold', POTs); probabilistic models of flood frequency using POTs are, in effect, fitted using censored data. The value of the results is likely to be restricted by assumptions about the probabilistic structure of flood sequences; in one case that their distribution (at different sites) is bivariate lognormal, and, for the POT model, that floods occur as a Poisson process with POTs exponentially distributed. The results show, in strictly qualitative terms, the circumstances in which information might be gained by the use of censored data at two sites, and how large (or small) the gains might be. (Author's abstract)
W91-12217

HILLSLOPE INFILTRATION: DIVERGENT AND CONVERGENT SLOPES.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W91-12220

INFILTRATION AND DOWNSLOPE UNSATURATED FLOWS IN CONCAVE AND CONVEX TOPOGRAPHIES.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W91-12221

TERRAIN-BASED CATCHMENT PARTITIONING AND RUNOFF PREDICTION USING VECTOR ELEVATION DATA.
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
I. D. Moore, and R. B. Grayson.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1177-1191, June 1991. 13 fig, 1 tab, 75 ref. Minnesota Agricultural Experiment Station Grants SES-8912042 and SES-8912938.

Descriptors: *Flow models, *Hydrologic models, *Mapping, *Model studies, *Rainfall-runoff relationships, *Runoff forecasting, *Runoff rates, *Terrain analysis, *Topography, Computer models, Overland flow, Spatial distribution.

An automated method of partitioning catchments into interconnected elements using a 'stream tube' approach and vector or contour-based digital elevation models is presented. With this form of partitioning, hydrologic models can be structured based on the hydraulics of flow within a catchment. The effects of topography on runoff producing mechanisms and spatially distributed flow characteristics (such as flow depth and velocity) can be directly and realistically accounted for in the models. The method allows complex three-dimensional flow problems to be reduced to a series of coupled one-dimensional problems in areas with complex terrain. Two simple process-oriented hydrologic models that demonstrate the utility of this form of partitioning are presented. The first models subsurface flow-saturation overland flow and the second models Hortonian overland flow. Results from the subsurface flow model indicate that the assumption that the potential gradients driving the movement of water in the landscape can be approximated by the land surface gradient may not be appropriate for modelling shallow subsurface flow in landscapes with high effective hydraulic conductivities. Results from the two simple models demonstrate that terrain-based models of hydrologic processes can be powerful tools for use in computational hydrology. (MacKeen-PTT)
W91-12232

CHANGING RESPONSES IN HYDROLOGY: ASSESSING THE UNCERTAINTY IN PHYSICALLY BASED MODEL PREDICTIONS.
Lancaster Univ. (England). Centre for Research on Environmental Systems.
A. M. Binley, K. J. Beven, A. Calver, and L. G. Watts.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1253-1261, June 1991. 10 fig, 4 tab, 21 ref. National Environmental Research Council Grant GR3/6264.

Descriptors: *Hydrologic models, *Hydrology, *Model studies, *Rainfall-runoff relationships, *Uncertainty, Gwy Catchment, Hydrographs, Land use, Mathematical studies, Monte Carlo method, Prediction, Rainfall distribution, Storms, Wales.

The determination and utility of a measure of predictive uncertainty in the Institute of Hydrology distributed model (IHDM) was investigated using the methods of Rosenblueth and Monte Carlo simulation in an application to an upland catchment in Wales (Gwy catchment). It was shown that the Rosenblueth method allows a reasonable first estimation of the uncertainty limits on the basis of a small number of simulation runs, but the Monte Carlo method may be preferable if details of responses are required, in particular where that distribution may be highly skewed. For the prediction of storm responses alone, large changes in the predicted hydrographs result from changes in land use for the Gwy catchment. Results indicate that the uncertainty bounds for physically based models are quite wide, even when parameter values have been constrained by calibration. A continuing conjunctive use of modeling and field measurement is recommended where significant land use changes are being considered. (MacKeen-PTT)
W91-12239

HIERARCHICAL APPROACH TO REGIONAL FLOOD FREQUENCY ANALYSIS.
Consiglio Nazionale delle Ricerche, Roges di Rende (Italy). Ist. di Ricerca per la Protezione Idrogeologica nell' Italia Meridionale ed Insulare.
S. Gabriele, and N. Arnell.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1281-1289, June 1991. 3 fig, 4 tab, 15 ref, append.

Descriptors: *Annual floods, *Flood frequency, *Floods, *Model studies, *Regional analysis, *Statistical analysis, Flood forecasting, Mathematical studies, Simulation analysis, Variation coefficient.

A hierarchical approach to regional flood frequency estimation is described, where higher-order parameters controlling the skewness of annual maximum floods are determined from larger regions than are used for determining parameters controlling the coefficient of variation. Such an approach is justified on practical grounds by changes in the sample size needed to obtain an estimate with a given degree of reliability. Computer simulation experiments demonstrated the increased efficiency in quantile estimation when regions with assumed constant skewness are subdivided into subregions within which the coefficient of variation is assumed constant. Comparison of two-component extreme value estimation procedures support the general conclusion that the choice of a flood frequency model to be applied must be based on the observed characteristics of the flood data. (MacKeen-PTT)
W91-12242

FRACTAL STRUCTURES OF RIVER PLAN FORMS.
Akademiya Nauk Moldavskoi SSR, Kishinev. Inst. of Geophysics and Geology.
V. I. Nikora.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1327-1333, June 1991. 6 fig, 1 tab, 13 ref.

Descriptors: *Channel morphology, *Fractals, *Geomorphology, *Mathematical studies, *River beds, *Rivers, *Topography, Braided streams, Geometry, Moldavia, River basins, Soviet Union, Structural geology, Terrain analysis.

The basis of existing methods for the quantitative description of the plan geometry of rivers is the determination of individual meander bends (macroforms). At the level of the morphologically homogeneous river section, however, macroform parameters alone do not seem adequate to describe the geometry. The concept of fractals is used to derive new parameters for the description of river plan forms. Fractal behavior was demonstrated for 46 river sections in Moldavia from measurements made from existing topographic maps. Internal and

external fractal scales were found to limit the range of fractal behavior: width of the river channel, B, and width of the river valley floor, B(0), respectively. Using this idea together with elements of fractal geometry, a relation among the sinuosity, B, B(0), and the fractal dimension D of the river bed pattern was obtained. D is proposed as a new and informative parameter for describing the internal structure of the plan pattern of both single-thread and multithread rivers. (Author's abstract)
W91-12246

FLOW DYNAMICS IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA.
Royal Roads Military Coll., Victoria (British Columbia). Dept. of Physics.
For primary bibliographic entry see Field 2L.
W91-12251

LIFE HISTORY AND DISTRIBUTION OF MAYFLIES (EPHEMEROPTERA) IN SOME ACID STREAMS IN SOUTH CENTRAL ONTARIO, CANADA.
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-12259

NEOTECTONIC EFFECTS ON SINUOSITY AND CHANNEL MIGRATION, BELLE FOURCHE RIVER, WESTERN SOUTH DAKOTA.
Indiana State Univ., Terre Haute. Dept. of Geography and Geology.
For primary bibliographic entry see Field 2J.
W91-12263

CONTRIBUTION TO THE BIOLOGICAL DESCRIPTION OF RELATIONS BETWEEN SURFACE AND UNDERGROUND WATERS: VULNERABILITY OF AQUIFERS TO RIVER POLLUTION (ESSAI DE DESCRIPTION BIOLOGIQUE DES INTERACTIONS ENTRE EAU DE SURFACE ET EAU SOUTERRAINE: VULNERABILITE D'UN AQUIFERE A LA POLLUTION D'UN FLEUVE).
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France). Div. Qualite des Eaux.
For primary bibliographic entry see Field 5B.
W91-12271

BIOLOGICAL AND ECOLOGICAL STUDY OF THE AQUATIC OLIGOCHAETES OF THE RIVER TAMBRE AND ITS ENVIRONMENT (GALICIA, SPAIN) (ETUDE BIOLOGIQUE ET ECOLOGIQUE DES OLIGOCHETES AQUATIQUES DE LA RIVIERE TAMBRE ET DE SES MILIEUX ASSOCIES (GALICE, ESPAGNE)).
Dpto. Bioloxia Animal, Univ. A Cornua, Campus da Zapateira s/n., 15071 A Coruna, Spain.
E. Martinez-Ansemil.
Annales de Limnologie ANLIB3, Vol. 26, No. 2/3, p 131-151, 1990. 11 fig, 3 tab, 65 ref. English summary.

Descriptors: *Aquatic populations, *Biological studies, *Ecosystems, *Oligochaetes, *Rivers, *Tambre River, Annelids, Aquatic animals, Distribution patterns, Ecology, Galicia, Seasonal variation, Spain.

Communities of oligochaetes living in the Tambre River, a small river flowing into the Atlantic and its environments (lagoon, reservoir, ria) are described. The study examines spatial distributions of the different populations and analyzes the chief factors responsible for these distributions. Data on seasonal changes of the principal populations and their reproductive periods complete the faunistic study of oligochaetes found in these localities. (Author's abstract)
W91-12272

CHEMICAL CHARACTER AND ORIGIN OF ORGANIC ACIDS IN STREAMS AND SEEPAGE LAKES OF CENTRAL MAINE.
Illinois Univ., Urbana. Dept. of Forestry.
For primary bibliographic entry see Field 2H.
W91-12275

STOCHASTIC ANALYSIS OF ACID SHOCKS GENERATED BY MIXED HYDROLOGICAL PROCESSES.
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
A. G. Bobba, D. C. L. Lam, W. G. Booty, D. S. Jefries, and R. L. Thomas.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 239-250, October 1990. 9 fig, 29 ref.

Descriptors: *Acid rain, *Acid streams, *Acidification, *Hydrogen ion concentration, *Mersey River, *Stochastic models, Canada, Nova Scotia, Ontario, Statistical analysis, Statistical models, Stochastic hydrology, Stochastic process, Turkey Lake, Water chemistry.

High H(+) concentration of streamflow events were analyzed in terms of the probability of magnitude, frequency, duration, and time of occurrence. Simple methods of representing the timing and duration of high H(+) concentration flows as stochastic variables are presented, and existing stochastic models are applied to the probability distributions of the annual frequency of high H(+) ion concentration flows and their magnitudes. A consideration of the statistical properties of these stochastic variables lead to the development of a technique with which higher H(+) concentration flow events exceeding any higher level of interest may be investigated without resorting to a reanalysis of the historical data. The modified stochastic model has been successfully applied to Turkey Lake, Ontario and the Mersey River watershed in Nova Scotia, in order to predict acid shock event probability distribution of frequency, duration and magnitude. The proposed stochastic model can be applied to any watershed in the world which is affected by acid rain. (Lantz-PTT)
W91-12294

MICRO-ENVIRONMENTAL CHARACTERISTICS OF FILAMENTOUS ALGAL COMMUNITIES IN FLOWING FRESHWATERS.
Montana State Univ., Bozeman. Dept. of Biology.
W. K. Dodds.
Freshwater Biology FWBLAB, Vol. 25, No. 2, p 199-209, April 1991. 77 fig, 2 tab, 29 ref. NSF Fellowship BSR-8700142.

Descriptors: *Algae, *Ecosystems, *Filamentous algae, *Streamflow, Chlorophyta, Diatoms, Epiphytes, Flow rates, Hydrogen ion concentration, Nutrients, Oxygen, Species diversity.

Filamentous algae in flowing freshwaters can represent a spatially and temporally distinct sub-habitat for epiphytic diatom communities. This subhabitat is described in a low discharge, spring-fed stream with extensive filamentous green algal mats, and in a tuft of Cladophora glomerata (L.) Kutzing from a large river. Oxygen micro-electrodes, a thermistor current velocity probe, a standard pH probe and water chemistry were employed to assess spatial heterogeneity. Temporal patterns of epiphytic colonization were evaluated on filamentous artificial substrates. There were steep gradients in the low discharge stream. At mid-day, O2 ranged from 0-1.5 times air-saturated O2 concentrations, pH varied from 7.25-8.0, and current velocity spanned 0-0.5 m/sec. Areas near the surface of algal mats had high O2, pH and current velocity. These patterns were correlated with epiphyte community structure. In the interior of C. glomerata tufts O2 concentration was raised and current velocity depressed compared to the surrounding water, even when external current velocity was as high as 0.4 m/sec. After 35 days of colonization of artificial substrate in the low discharge environment, epiphyte communities were similar to those on filamentous algae. Epiphyte diversity on artificial substrates subsequently decreased compared to natural substrates as did the similarity between the types of substrates, suggesting that microscale renewal of epiphyte habitat (growth of filamentous algae) maintains high epiphytic diversity. (Author's abstract)
W91-12308

LONGITUDINAL VARIATION IN RECOLONIZATION RATES OF MACROINVERTEBRATES ALONG AN UPLAND RIVER IN SOUTHEASTERN AUSTRALIA.
Museum of Victoria, Abbotsford (Australia). Centre for Stream Ecology.
R. Marchant, P. S. Lake, and T. J. Doeg.
Freshwater Biology FWBLAB, Vol. 25, No. 2, p 349-356, April 1991. 2 fig, 4 tab, 14 ref. Australian Water Research Advisory Council Grant No. 85/3.

Descriptors: *Acheron River, *Ecosystems, *Macroinvertebrates, *Population dynamics, *Recolonization, Australia, Benthic fauna, Flooding, Seasonal variation, Shear stress, Species composition.

Recolonization rates of benthic invertebrates were estimated at five sites in the catchment of the Acheron River, in spring (October) and in summer (January). The sites ranged from those that experience short floods and high shear stress at the streambed (upstream sites) to those that experience prolonged floods and low shear stress (downstream sites). It was hypothesized that these differences would affect recolonization rate. In October, absolute rates of recolonization of taxa (number of taxa 0.05/sq m/d) onto 1 sq m patches of substratum, which had been raked to remove fauna, did not vary between the three sites studied, nor did the relative rates of recolonization of taxa (absolute rate/mean number of taxa in control samples, which were taken from adjacent undisturbed patches of substratum). Absolute rates of recolonization of individuals (number of individuals 0.05/sq m/d) were proportional to the mean number of individuals (absolute rate/mean number of individuals in control samples) did not vary between sites. In January, absolute rates of recolonization either of taxa or individuals were positively correlated with the mean densities of taxa or individuals in control samples; relative rates did not vary between the four sites studied. It was concluded that the benthic invertebrate communities at the various sites do not adapt to variations in flooding regime by altering relative recolonization rates. Absolute recolonization rates are directly proportional to the prevailing number of taxa or individuals at a site. (Author's abstract)
W91-12312

CHANGES IN STRUCTURE AND COMPOSITION OF AN ASSEMBLAGE OF HYDROPORUS SPECIES (COLEOPTERA: DYTISCIDAE) ALONG A PH GRADIENT.
Illinois State Univ., Normal. Dept. of Biological Sciences.
S. A. Juliano.
Freshwater Biology FWBLAB, Vol. 25, No. 2, p 367-378, April 1991. 4 fig, 5 tab, 42 ref. NSF/NATO Postdoctoral Fellowship RCD-8651708.

Descriptors: *Acid rain effects, *Beetles, *Ecosystems, *Ephemeral streams, *Hydrogen ion concentration, *Population dynamics, *Species composition, Distribution patterns, Species diversity.

Patterns of total abundance and species relative abundances in an assemblage of predatory dytiscid beetles of the genus Hydroporus were examined along a pH gradient within a ditch in northeast England. During spring, total abundance of adult Hydroporus was greatest at the less acidic (pH 5.6-6.2) upstream sites, whereas total abundance of larval Hydroporus was greatest at the more acidic (pH 4.5) downstream sites. Both adults and larvae were more abundant in samples from samples from the edge than from the middle of the ditch. Species number and evenness did not differ along the pH gradient. Species relative abundance patterns varied along the pH gradient, with particular species dominating at different sites. However, relative abundances of species changed discontinuously along the p H gradient. Comparison of species abundance patterns along this pH gradient with published patterns of presence/absence among bodies of water with different pH revealed that species relationships with pH are often not consistent. Possible sources of this inconsistency are: geographic variation in species' pH preferences; complex responses of individual species to many fac-

tors in addition to pH; or random variation among sites due to colonization and extinction history. The overall results suggest that pH is not the only, or even the most important, factor influencing Hydroporus populations and assemblage organization. (Author's abstract)
W91-12314

SURFACE-SUBSURFACE WATER INTERACTIONS IN AN ALLUVIATED MOUNTAIN STREAM CHANNEL.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
N. Mathews Castro, and G. M. Hornberger.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1613-1621, July 1991. 8 fig, 4 tab, 23 ref.

Descriptors: *Alluvial rivers, *Dry Run, *Mountain streams, *Solute transport, *Surface-groundwater relations, *Tracer studies, Environmental tracers, Gravel, Groundwater movement, Mathematical models, Mathematical studies, Model studies, Streambeds, Streamflow, Time series analysis, Virginia, Wells.

Data from an instream tracer experiment performed in North Fork Dry Run, Shenandoah National Park, Virginia, illustrate that the transport of water and conservative solute in the stream is greatly influenced by interaction with water present in both the relatively shallow gravel bed and in the relatively deeper alluvial infill material. The shape of concentration-time curves from the field tracer experiment exhibit 'storage' of tracer in the subsurface-short-term storage imposed by exchange with the gravel bed and long-term storage by exchange with the deeper alluvial infill. Time series models fit the observed concentration data very well. Estimates of mixing volumes generated by the time series analysis indicate that a large volume of the gravel bed participates in rapid mixing with the surface stream. At one point along the study reach, a second-order time series model was supported by the data, suggesting two independent, parallel flow paths. Observations of tracer in wells more than 10 m from the stream and the very extended recession of the tracer in the stream where it flows over a bedrock ledge, support the contention that the deeper alluvium plays an important role in transient storage of solute in North Fork Dry Run. The work implies that physically-based models to predict transport and storage in alluviated mountain catchments, may have to account for interactions between the stream and large portions of its floodplain. (Author's abstract)
W91-12336

SHORT-TERM FLOOD RISK PREDICTION: A COMPARISON OF THE COX REGRESSION MODEL AND A CONDITIONAL DISTRIBUTION MODEL.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
M. R. Futter, J. A. Mawdsley, and A. V. Metcalfe.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1649-1656, July 1991. 8 fig, 2 tab, 11 ref.

Descriptors: *Conditional Distribution Model, *Cox Regression Model, *Flood forecasting, *Flood hazard, *Risk analysis, *Statistical models, Comparison studies, Data interpretation, Flood data, Historic floods, Model studies, United Kingdom.

Two models for estimating the risk of a flood exceeding some critical threshold within a few days (the Smith-Karr Model and the Ettrick Model), which take account of the season and prevailing catchment conditions, have recently been published. The models are fitted to a 1000-year synthetic data set, to compare the results with empirically determined risk estimates. After some modifications to the Smith and Karr method both models demonstrated reasonable accuracy. A second comparison was then made using data from a United Kingdom catchment. The Smith and Karr model was further modified to allow risk estimates for up to 30 days ahead to be made. Both models were applied to both data sets for 30 day ahead estimates, and the results demonstrate the sensitivity of the risk to prevailing conditions at the beginning of the period. Fitting the models to a data set requires, in both cases, numerical solution of equations. The Smith and Karr model uses a flow threshold set at the critical value of interest; this limits the data to such an extent that on occasions they are insufficient to adequately fit the model. In contrast, the Ettrick model has a rainfall threshold which can be set at a level such that an adequate number of independent events should be available for fitting the probability distributions. (Lantz-PTT)
W91-12339

COUPLED CHANNEL NETWORK GROWTH AND HILLSLOPE EVOLUTION MODEL: 1. THEORY.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
G. Willgoose, R. L. Bras, and I. Rodriguez-Iturbe.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1671-1684, July 1991. 9 fig, 2 tab, 39 ref, 2 append. NSF Grant 8513556-ECE, Army Research Office DAAL03-89-KK-0151, and National Weather Service Cooperative Research Agreement NA86AA-H-HY123.

Descriptors: *Channeling, *Drainage patterns, *Geomorphology, *Mathematical models, *Model studies, *Sediment transport, Erosion, Geohydrology, Hydrologic models, Mathematical equations, Surface flow, Theoretical analysis.

A model is presented of the long-term evolution of catchments, the growth of their drainage networks, and the changes in elevations within both the channels and the hillslopes. Elevation changes are determined from continuity equations for flow and sediment transport, with sediment transport being related to discharge and slope. The central feature of the model is that it explicitly differentiates between the sediment transport behavior of the channels and the hillslopes on the basis of observed physics, and the channel network extension results solely from physically based flow interactions on the hillslopes. The difference in behavior of channels and hillslopes is one of the most important properties of a catchment. The flow and sediment transport continuity equations in the channel and the hillslope are coupled and account for the long-term interactions of the elevations in the hillslope and in the channels. Sediment transport can be due to fluvial processes, creep, and rockslides. Tectonic uplift may increase overall catchment elevations. The dynamics of channel head advance, and thus network growth, are modeled using a physically based mechanism for channel initiation and growth where a channel head advances when a channel initiation function, nonlinearly dependent on discharge and slope, exceeds a threshold. This threshold controls the drainage density of the basin. A central component of the model is that erosion in the channels takes place at a faster rate than in the hillslope. This preferential erosion in the channels results in a convergence of the flow on the hillslopes toward the channels. This convergence trigger channel head advance. Thus, the interaction between the hillslopes and the channels over long time scales is central to the final form of the channel network and the hillslopes. A sample simulated catchment was examined. This simulation demonstrated the process by which catchments grow and develop their observed form. It was also demonstrated that the physics of the evolution of the catchment and network growth are consistent with observed characteristics of field catchments. (See W91-12343) (Lantz-PTT)
W91-12342

COUPLED CHANNEL NETWORK GROWTH AND HILLSLOPE EVOLUTION MODEL: 2. NONDIMENSIONALIZATION AND APPLICATIONS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
G. Willgoose, R. L. Bras, and I. Rodriguez-Iturbe.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1685-1696, July 1991. 177 fig, 1 tab, 16 ref. NSF Grant 8513556-ECE, Army Research Office DAAL03-89-KK-0151, and National Weather Service Cooperative Research Agreement NA86AA-H-HY123.

Descriptors: *Channeling, *Geomorphology, *Mathematical models, *Mathematical studies, *Model studies, *Slopes, Drainage, Drainage systems, Geohydrology, Mathematical equations, Networks.

A series of non-dimensional numbers, formulated in terms of observable physical quantities, can be used to define similarity conditions between basins. The promise of this approach lies in the ability to regionalize properties, develop analogs, and even design field and laboratory experiments. Results were used to study catchment similitude between laboratory and field settings, highlighting the difficulties to be expected in proper experimental design. The potential of regionalization of properties was illustrated by relating drainage density and the rate of catchment growth to controlling non-dimensional numbers. Using the drainage density and the definition of relevant non-dimensional numbers, a relationship between hillslope scales, such as slope and length, and catchment scales was developed. Hence, the local scales are not independent of the regional catchment scales which in turn are very much a function of regional geology and climate. Illustrations were used to show how the highly nonlinear interactions between channel head advance and contributing hillslopes lead to a network growth process that is highly sensitive to initial conditions. This condition, although deterministic in origin, leads to the observed apparent randomness in the topology and geomorphology of basins. (See W91-12342) (Lantz-PTT)
W91-12343

PHYSICAL EXPLANATION OF AN OBSERVED LINK AREA-SLOPE RELATIONSHIP.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 2J.
W91-12344

GOODNESS-OF-FIT TESTS FOR REGIONAL GENERALIZED EXTREME VALUE FLOOD DISTRIBUTIONS.
Institute of Flood Control and Drainage Research, Dacca (Bangladesh).
J. U. Chowdhury, J. R. Stedinger, and L. H. Lu.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1765-1776, July 1991. 2 fig, 8 tab, 45 ref, 2 append. NSF Grant CME 8010889.

Descriptors: *Data interpretation, *Distribution patterns, *Flood forecasting, *Flood profiles, *Statistical analysis, Monte Carlo method, Probability distribution, Regional planning, Statistical methods.

Critical values and formulas were developed for computing several goodness-of-fit tests for the generalized extreme value (GEV) distribution. These tests can check if data available for a site are consistent with a regional GEV distribution, except for scale, or if the data are consistent with a GEV distribution with a regional value of the shape parameter. Three tests employ unbiased probability-weighted moment (PWM) estimators of the L moment coefficient of variation (L-CV), and coefficient of skewness (L-CS) using formulas for their variances in small samples. In a Monte Carlo power study, the L-CV test was often more powerful than the Kolmogorov-Smirnov test at detecting L-CV inconsistencies. A test based upon L-CS generally has equal or greater power than the probability plot correlation test at detecting L-CS differences; both are poor at detecting thin-tailed alternatives. Finally, a new chi-squarer test based upon sample estimates of both the L-CV and L-CS, and their anticipated cross correlation, was much better than other tests at detecting departures from the assumed L-CV, L-CS, or both, particularly when the regional distribution was highly skewed. (Author's abstract)
W91-12350

NEW PERSPECTIVE ON THE VEDERNIKOV NUMBER.
San Diego State Univ., CA. Dept. of Civil Engineering.
V. M. Ponce.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1777-1779, July 1991. 2 tab, 17 ref.

Descriptors: *Channel flow, *Dynamic waves, *Hydraulics, *Kinematic waves, *Vedernikov Number, Froude number, Hydraulic properties, Mathematical studies, Surface runoff.

There are three characteristic speeds in open channel hydraulics: (1) the mean flow velocity, u; (2) the relative celerity of kinematic waves, v; and (3) the relative celerity of dynamic waves, w. These three speeds give rise to two independent dimensionless ratios: (1) the dimensionless relative celerity of kinematic waves c sub k = v/u; and (2) the dimensionless relative celerity of dynamic waves c sub d = w/u. The reciprocal of c sub d is the Froude number FR = u/w. The Vedernikov number if the third ratio V = u/w. Recent developments in the linear theory of surface runoff show that the Vedernikov number has a significant role in extending the concept of hydraulic diffusivity to the realm of dynamic waves. This new perspective makes possible the modeling of catchment dynamics using diffusion waves and including inertial effects, under a wide range of boundary friction and cross-sectional shape specifications. (Author's abstract)
W91-12351

ACCURACY OF SELECTED TECHNIQUES FOR ESTIMATING ICE-AFFECTED STREAMFLOW.
Geological Survey, Madison, WI.
For primary bibliographic entry see Field 7B.
W91-12356

CALCULATION OF TOTAL CONVEYANCE IN NATURAL CHANNELS.
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
J. Garbrecht, and G. O. Brown.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 6, p 788-798, June 1991. 5 fig, 2 tab, 9 ref, append.

Descriptors: *Channel flow, *Channel morphology, *Mathematical models, *Open-channel flow, *Water-carrying capacity, Channels, Estimating, Hydrologic models, Model studies, Shear, Streamflow, Velocity.

The evaluation of total conveyance using the summation approach over section elements was investigated for one-dimensional, uniform, steady-state flow in simple concave channels. The subdivision of a concave section into elements, the introduction of a lateral velocity gradient, the neglect of lateral shear between the elements, and the computation of the nonlinear conveyance as a linear summation of its components all contribute to the overestimation of total conveyance computed by the summation approach. The overestimation was quantified for six selected section shapes. The degree of overestimation was found to be a function of section shape and increases with the number of section elements used in the summation. Based on the integral form of the summation approach, rectangular and trapezoidal sections with width-to-depth (W/D) ratios above 20, have a computed total conveyance value within 5% above the value of the undivided section. For W/D ratios <10, the summation approach produces significantly higher total conveyance values for 5 of 6 section shapes. In this low range of W/D ratios, the summation approach should be avoided. In cases where the summation approach is required, the overestimation can be controlled by minimizing the number of section subdivisions. (Author's abstract)
W91-12362

EROSION OF COHESIVE BOTTOM SEDIMENTS: THE INFLUENCE OF BENTHOS.
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2J.
W91-12364

AUTOMATIC MEASUREMENT OF BOUNDARY SHEAR STRESS AND VELOCITY DISTRIBUTIONS IN DUCT FLOW.
Cranfield Inst. of Tech. (England). School of Mechanical Engineering.
D. G. Rhodes, E. J. Lamb, R. J. Chance, and B. S. Jones.
Journal of Hydraulic Research JHYRAF, Vol. 29, No. 2, p 179-187, 1991. 5 fig, 3 ref.

Descriptors: *Automation, *Boundaries, *Flow velocity, *Instrumentation, *Measuring instruments, *Pipe flow, *Shear stress, *Turbulent flow, Computers, Hydraulics, Model studies, Streamflow, Velocity distribution.

A traverse gear was designed for the automatic measurement of boundary shear stress and velocity distributions in a fully developed turbulent flow. The equipment was designed to investigate the mean flow structure in a duct with a compound cross section; the data collected will be used to develop mathematical models for river hydraulics. The traverse gear is suspended from support blocks which are dowelled and bolted to the central transverse member of a mild steel frame. Stepper motor control and pressure transducer logging data are effected by means of a BBC Master Series 128 microcomputer. Design features eliminate backlash, ensuring that the probe can be driven accurately and repeatably to given reference points. During experimental operation, the quality of results was checked by integrating the local shear stress data at the measurement section, and comparing the cross-section mean value thus obtained with that derived from measurements of the upstream gradient. Similarly, cross-section mean velocity at the measurement section was obtained first from integrated Pitot-static tube data, and second from the flow rate measured using an upstream orifice plate meter. For 33 different compound duct geometries, the mean discrepancy between velocities obtained by the two methods was 0.32%. The mean discrepancy between shear stresses was 1.97%. (Doria-PTT)
W91-12366

DRIFT OF BENTHIC INVERTEBRATES IN SALMON-PRODUCING RIVERS OF EUROPEAN NORTH USSR DURING THE ICE-COVERED PERIOD (IN RUSSIAN).
Akademiya Nauk SSSR, Syktyvkar. Inst. Biologii.
For primary bibliographic entry see Field 2C.
W91-12375

PHYSICO-CHEMICAL DISTURBANCES ASSOCIATED WITH SPATIAL AND TEMPORAL VARIATION IN A MEDITERRANEAN RIVER.
Barcelona Univ. (Spain). Dept. de Ecologia.
F. Sabater, J. Armengol, and S. Sabater.
Journal of the North American Benthological Society JNASEC, Vol. 10, No. 1, p 2-13, March 1991. 6 fig, 1 tab, 39 ref. Comision Asesora de Investigacion Cientifica y Tecnica Contract 478/81.

Descriptors: *Dam effects, *Land use, *Spatial variation, *Temporal variation, *Ter River, *Water chemistry, Headwaters, Principal component analysis, Reservoirs, Spain, Spates, Water pollution.

The Ter River, Spain, experiences various disturbances (spates, pollution, reservoirs) that result in discrete zones along the river. Physicochemical data were used to measure and interpret the dynamics of these zones through time and space. Principal Component Analysis (PCA) of the physicochemical variables revealed longitudinal chemical structure (FI) and temporal variation in chemical composition due to discharge fluctuations (FII). It was found that the chemistry of headwater regions is more constant than lower reaches since the river is heavily perturbed by human activities downstream. The chemistry of lower reaches is more time dependent. When inputs of energy are rhythmic, the river exhibits cyclic fluctuations and regular patterns of temporal and spatial organization. However, when there are important irregular external inputs of energy, temporal or spatial discontinuities occur. Spates are the main cause of temporal catastrophic changes and therefore, they should be interpreted as temporal discontinuities. Reservoirs or inputs of wastewater represent discontinuities in space. These external inputs are the main source of external energy invested in horizontal transport and mark the beginning of a new episode of a temporal pattern. The Ter River shows an ability to become adapted to new conditions caused by such perturbations. (Lantz-PTT)
W91-12395

EXPERIMENTAL EVIDENCE FOR NITROGEN LIMITATION IN A NORTHERN OZARK STREAM.
Missouri Univ.-Columbia. School of Natural Resources.
K. Lohman, J. R. Jones, and C. Baysinger-Daniel.
Journal of the North American Benthological Society JNASEC, Vol. 10, No. 1, p 14-23, March 1991. 3 fig, 5 tab, 46 ref.

Descriptors: *Nitrogen, *Nutrients, *Stream chemistry, Biomass, Chlorophyll a, Low flow, Nitrates, Periphyton, Phosphates, Phosphorus, Snails, Water quality.

Nutrient enrichment experiments were conducted during low flow periods in 1985 and 1986 in a northern Ozark stream characterized by low nitrate-N concentrations and molar ratios of TN:TP < 20:1. Enrichment with nitrate to a concentration 3-6 times greater than ambient, either alone or in combination with phosphate additions, stimulated periphytic chlorophyll a by 4-6 fold. An intermediate increase in chlorophyll a in response to phosphate addition was observed in 1985 when TN:TP averaged 19:1. Differences in periphyton accrual among treatments were influenced by snail grazing (Goniobasis) during 1986, when periphyton biomass in N-enriched treatments continued to increase over the 30-d enrichment period, but remained at low levels in control and P-enriched treatments. Low nitrate-N concentrations and TN:TP </= 20:1 were also characteristic of 16 sites on 10 streams in the northern Ozark Plateau during low flow periods in 1985 and 1986, suggesting that nitrogen limitation may be common in the region. (Author's abstract)
W91-12396

PHOSPHORUS AND NITROGEN DYNAMICS IN STREAMS DURING A WILDFIRE.
Montana Univ., Polson. Flathead Lake Biological Station.
C. N. Spencer, and F. R. Hauer.
Journal of the North American Benthological Society JNASEC, Vol. 10, No. 1, p 24-30, March 1991. 4 fig, 19 ref.

Descriptors: *Ash, *Fire effects, *Forest watersheds, *Nitrogen, *Phosphorus, Air pollution, Ammonium, Dissolved nutrients, Leaching, Nitrates, Nitrites, Stream chemistry, Surface water.

Various studies report changes in phosphorus and nitrogen concentrations in surface waters after wildfires; however, none of these studies include nutrient data collected during actual wildfire activity. In this study, water chemistry data was collected from several streams as a large (15,500 ha) intense firestorm passed through their watersheds. Phosphorus and nitrogen concentrations increased from 5 to 60 fold over background levels within the first two days of the fire, with maximum recorded concentrations for dissolved nutrients reaching as high as 135 microgm/L soluble reactive phosphorus, 261 microgm/L ammonium, and 61 microgm/L nitrate+nitrite. Total phosphorus levels increased up to 206 microgm/L and total nitrogen levels increased up to 349 microgm/L. Nutrient concentrations declined to background levels typically < 5-10 microgm/L within several days to several weeks. Experimental evidence suggests that the primary source of phosphorus was

from leaching of ash deposited directly into the streams during the firestorm while the primary source of nitrogen appeared to be from diffusion of smoke gases into the stream waters. (Author's abstract)
W91-12397

NUTRIENT CYCLING BY BIOFILMS IN RUNNING WATERS OF DIFFERING NUTRIENT STATUS.
Waterloo Univ. (Ontario). Dept. of Biology.
B. J. Paul, H. C. Duthie, and W. D. Taylor.
Journal of the North American Benthological Society JNASEC, Vol. 10, No. 1, p 31-41, March 1991. 2 fig, 4 tab, 57 ref.

Descriptors: *Benthic environment, *Biofilms, *Cycling nutrients, *Nutrients, *Stream chemistry, Algae, Aquatic bacteria, Biomass, Carbon fixing, Nuclear track autoradiography, Ontario, Phosphorus, Succession.

The autotrophic and heterotrophic nature of attached algal and bacterial populations in streams was investigated in July and August 1986. Glass slides were colonized in two rivers in Algonquin Park, Ontario, that differed in their concentration of bioavailable phosphorus (P). The importance of three abundant algal species was demonstrated by considering their activities on a cellular level using nuclear track autoradiography (NTA). Community biomass accrual, carbon fixation, and phosphate uptake were monitored at bi-weekly intervals and were generally reflective of that of the dominant algal species in each river. The authors propose that, in running waters, nutrients do not cycle in place but are continually translocated downstream before being re-used by attached organisms. This mode of recycling was demonstrated by monitoring biotic incorporation, release, and subsequent downstream re-incorporation of radiolabelled P and carbon (C) metabolites at the community and cellular levels. The river with less bioavailable P re-assimilated the P metabolites more quickly, but C re-assimilation was similar in the two rivers. This may account for observations that biomass development in running waters may exceed that predicted from empirical P-biomass relationships. Data presented also provide evidence that the species succession, and consequently the tiered development of a biofilm, was the result of the differing abilities of species to sequester and recycle organic and inorganic nutrients from overlying waters. (Author's abstract)
W91-12398

EFFECTS OF DETRITUS LOADING AND FISH PREDATION ON LEAFPACK BREAKDOWN AND BENTHIC MACROINVERTEBRATES IN A WOODLAND STREAM.
North Carolina Univ. at Chapel Hill. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-12399

RELATIONSHIPS BETWEEN DEMOGRAPHIC FEATURES OF A PILL CLAM (PISIDIUM CASERTANUM) AND ENVIRONMENTAL VARIABLES.
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-12400

VERTICAL PROFILES OF COPPER IN SEDIMENTS FROM THE FLY DELTA AND GULF OF PAPUA (PAPUA NEW GUINEA).
Australian Inst. of Marine Sciences, Townsville.
For primary bibliographic entry see Field 5B.
W91-12408

NUMERICAL MODELLING OF FREE SURFACE FLOWS: STATE OF THE ART AT THE LABORATOIRE NATIONAL D'HYDRAULIQUE, EDF, CHATOU (MODELISATION NUMERIQUE DES ECOULEMENTS A SURFACE LIBRE: L'ETAT DE L'ART AU LABORATOIRE NATIONAL D'HYDRAULIQUE (LNH) DE L'EDF A CHATOU).
J. M. Hervouet, and P. Pechon.
Houille Blanche HOBLAB, Vol. 1991, No. 2, p 93-106, 1991. 11 fig, 11 ref. English summary.

Descriptors: *Hydraulics, *Mathematical models, *Model studies, *Streamflow, *Surface flow, Computer models, Computers, LIDO model, MITHDRIDATE model, NSL model, TELEMAC model, Wave propagation.

With experience gained over thirty years, the Laboratoire National d'Hydraulique (LNH) was able to set up powerful numerical models which rely on new techniques and the use of computers. These numerical models could also benefit from newly advanced knowledge in the area of physical processes. The models presented here are: NSL for wave propagation simulation; and LIDO, TELEMAC and MITHRIDATE, for modeling free surface flows. This article emphasizes the evolution of these methods and their computational environment. (Author's abstract)
W91-12412

DENSITY-DEPENDENT GROWTH, ECOLOGICAL STRATEGIES, AND EFFECTS OF NUTRIENTS AND SHADING ON BENTHIC DIATOM SUCCESSION IN STREAMS.
Louisville Univ., KY. Dept. of Biology.
R. J. Stevenson, C. G. Peterson, D. B. Kirschtel, C. C. King, and N. C. Tuchman.
Journal of Phycology JPYLAJ, Vol. 27, No. 1, p 59-69, February 1991. 9 fig, 1 tab, 69 ref.

Descriptors: *Diatoms, *Ecosystems, *Light effects, *Nutrients, *Population dynamics, *Stream biota, Algae, Benthos, Growth, Light intensity, Limnology, Nitrates, Phosphates, Species composition, Succession.

The importance of immigration, growth, and competition for nutrients and light in benthic diatom succession was studied in experimental channels in a low-nutrient stream. Diatom accumulation was greater in channels enriched with nitrate and phosphate (NP) than in control channels, reaching about 5 million and 2 millions cells/sq m, respectively, after 30 d. Shading during late stages of community development reduced algal standing crop. Synedrar ulna (Nitz.) Ehr. and Achnanthes minutissima Kutz. were codominant during early stages of community development in both habitats, but succession to an A. minutissima-dominated community was much faster in NP-enriched than in control conditions. Species dominating early stages tended to immigrate quickly, whereas species that increased in relative abundance during community development had either fast growth rates or fast immigration and average growth rates. Decreases in growth rates indicated that the resource supply became limiting during community development in control and enriched channels. Density-dependent competition was indicated because nutrient concentrations in the water column and light did not decrease during the 30-d study. Species autecologies were defined by effects of nutrient enrichment, shading, and community development on species growth rates. Differing autecologies of early and late succession species indicated that competition for nutrients was more important than competition for light. Species autecologies also indicated ecological strategies. The species most stimulated by nutrient enrichment were least able to maintain growth rates as algal abundances on substrata increased. In addition, the species which best sustained their growth rates during succession tended to have the highest immigration rates, indicating that drift and immigration may have been an important mechanism for the persistence of some populations when resources become limiting within thick benthic mats. (Author's abstract)
W91-12422

FLOW IN RIVER CHANNELS: NEW INSIGHTS INTO HYDRAULIC RETENTION.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
C. S. Reynolds, P. A. Carling, and K. J. Beven.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 2, p 171-179, April 1991.

Descriptors: *Dispersion, *Fickian models, *Model studies, *Open-channel flow, *Particle transport, *Sediment transport, *Solute transport, *Traveltime, Chlorophyll, England, Phytoplankton, Remote sensing, Severn River Basin.

The suitability of Fickian-type dispersion models to describe the fluvial transport of solutes and particulates has been questioned because of their tendency to underestimate, sometimes substantially, the actual clearance times for particular river reaches. However, such models assume a uniform velocity field, despite the existence of abundant evidence that 'dead-zones' are found in streams. The effect of these areas of low flow is to delay the downstream passage of solutes and suspensoids. In situ fluorimetry and airborne remote sensing were employed to detect spatial disparities in chlorophyll distribution. In studies conducted in the Severn basin, England, color-enhanced remote-sensed imagery of the chlorophyll contained in suspended river phytoplankton was sensitive to variability in the velocity structure in river channels and, in particular, to be useful in identifying zones of retentiveness. These zones become 'labeled' by higher concentrations of growing algae. This 'biological tagging' of the inherent patchiness of the river environment offers a useful approach for detecting and quantifying the retentiveness of fluid discharges both within and between large rivers. (Rochester-PTT)
W91-12471

CATCHMENT HYDROLOGY.
Agricultural Research Service, Tucson, AZ. Aridland Watershed Management Research Unit.
For primary bibliographic entry see Field 2A.
W91-12505

PROGRESS IN SURFACE WATER MODELING.
Notre Dame Univ., IN. Dept. of Civil Engineering.
J. J. Westerink, and W. G. Gray.
Reviews of Geophysics RVGPB4, Vol. Supp, p 210-217, 1991. 103 ref. Army Engineers Waterways Experiment Station Contract DACW 39-90-K-0021.

Descriptors: *Hydrological regime, *Literature review, *Model studies, *Rainfall-runoff relationships, *Streamflow forecasting, *Surface water, Computers, Hydrodynamics, Hydrologic budget, Streamflow.

During the last four years, research in numerical modeling of surface water bodies has led to some significant advances. More sophisticated computational frameworks which take advantage of rapidly increasing computer power have been developed. These include more complete fundamental equations describing the physical processes occurring, improved specification of the boundary conditions which drive the flow, and sophisticated numerical procedures which better describe the geometry of the simulation region and take advantage of the ever increasing power of the computer. In this paper, the contributions of U.S. scientists to modeling surface water flow are reviewed. Ocean circulation models and pollutant transport are not specifically included in this survey although some computational and theoretical advances have occurred in concert with these models. (Lantz-PTT)
W91-12506

CONFIDENCE INTERVAL FOR DESIGN FLOODS WITH ESTIMATED SKEW COEFFICIENT.
Institute of Flood Control and Drainage Research, Dacca (Bangladesh).
J. U. Chowdhury, and J. R. Stedlinger.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 7, p 811-831, July 1991. 1 fig, 8 tab, 42 ref. NSF Grant CME 8010889.

Descriptors: *Design floods, *Flood forecasting, *Flood hazard, *Risk assessment, *Statistical methods, *Uncertainty, Analysis of variance, Flood

damage, Flood plain management, Mathematical studies, Monte Carlo method.

Quantifying uncertainty in flood magnitude estimators is an important problem in floodplain development, including risk assessment for floodplain management; risk-based design of hydraulic structures; and estimation of expected annual flood damages. A method, based on the noncentral t-distribution, for constructing approximate confidence intervals for quantiles of a Pearson type-3 (P3) distribution when the coefficient of skewness is known is extended to the case when the coefficient of skewness is estimated by either (1) the at-site sample skew; (2) a generalized regional-average skew; or (3) a weighted average skew. The confidence intervals perform satisfactorily in Monte Carlo simulations. Confidence intervals generated using a three parameter asymptotic method and the Water Resources Council method, which ignores uncertainty in the weighted skew, perform poorly. The actual confidence of confidence intervals for a design flood can be much lower than the target if uncertainty in the skewness coefficient is ignored. It is important to distinguish between the sampling variability in the sample skew coefficient at the site and the likely variation of the true skews in the region when estimating the precision of a generalized skewness coefficient for the region. Five approximations of frequency factors for the P3 distribution are also evaluated. (Author's abstract)
W91-12559

KINEMATIC CHARACTERISTICS OF TRIBUTARIES OF THE VAKHSH RIVER IN THE FLOODING ZONE OF THE ROGUN RESERVOIR.
V. D. Gol'dina, D. N. Nabotov, S. I. Prokhorenko, and S. M. Sherman.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 490-496, 1991. 3 tab, 12 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 9-13, August 1990.

Descriptors: *Field tests, *Flow measurement, *Flow velocity, *Mathematical studies, *Rogun Reservoir, *Sediment load, *Sediment transport, *Sediment-water interfaces, *Streamflow, Flood plains, Froude number, Hydraulics, Hydrometeorology, Reynolds number, USSR.

Approximately 20 tributaries of the Vakhsh River will empty into the reservoir at the Rogun hydroelectric station. Of the 20 tributaries, only three have permanent observation stations recording hydrometeorological data. Few data on the runoff and sediment load were collected at these observation stations. Consequently, in July and August 1988, on-site investigations were performed on the right and left bank tributaries of the Vakhsh River during a low flow period when the danger of rockfalls and mudflows was minimal. The velocity characteristics were measured using Inguri-5 apparatus which consists of five current meters and a counting mechanism with five pulse counters. The field data were used to determine various hydraulic characteristics and stability parameters of the tributaries of the Vakhsh River. From the calculated Froude and Reynolds numbers, the coefficients proposed by V. M. Lokhtin and A. N. Kroshkin, the indices of dynamic stability, and parameters proposed by M. A. Velikanov and K. V. Grishanin were computed. The analysis of these coefficients and parameters proved inconclusive. No universal power-law or logarithmic profiles of the vertical flow velocity measurements were determined to be simultaneously applicable to the investigated tributaries. The Karman equation, used for calculating the mean turbulence characteristics, in combination with Nitikin's boundary conditions, showed good agreement with the vertical velocity distributions of the actual data under a variety of bottom roughness and sediment load conditions. The bed and suspended load discharges calculated for the tributaries of the Vakhsh River were insignificant. (Collins-PTT)
W91-12611

IDENTIFICATION OF HIGH-RISK ATMOSPHERIC AND SURFACE CONDITIONS FOR URBAN FLASH FLOODING IN LOUISIANA.
Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology.
K. K. Hirschboeck, and M. F. Coxe.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-192351. Price codes: A05 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute, Baton Rouge, Project Completion Report, 1991. 92p, 21 fig, 7 tab, 33 ref, 3 append. USGS Project No. G1565-02.

Descriptors: *Atmospheric processes, *Classification, *Flash floods, *Floods, *Louisiana, *Urban runoff, Climatology, Flood forecasting, Prediction, Rainfall intensity, Soil moisture, Synoptic analysis, Urban flash flood geographic information.

This study identified and cataloged significant flash floods that occurred in Louisiana's main urban areas, defined and described the synoptic atmospheric environment leading to flash flooding, and compared and contrasted the atmospheric and surface conditions that develop into urban flash floods in different parts of the state. The potential for flash flood occurrence can be estimated from the number of days having daily rainfall totals of > or = 2 inches. Actual days of occurrence of flash floods will take place on about 25%-50% of the potential flash flood days. In general, the southernmost cities of Louisiana have a higher potential for flash flood occurrence than the northernmost cities. Spring is the season most prone to both potential and actual urban flash flooding, although fall and early winter are also flood-prone seasons throughout most of Louisiana. Urban flash flooding has increased in frequency in recent years in Monroe and Alexandria, but decreased in Lafayette. Most urban flash floods in Louisiana occur in response to a frontal situation, supported by an upper air trough or cutoff low to the west, and frequently a squall line in association with the front. Disturbed tropical weather from tropical storms and hurricanes is also a source of flash flooding, primarily in summer and fall. The degree of soil moisture storage was found to be an important determinant of whether a potential flood would become an actual flood. An Urban Flash Flood Geographic Information System (UFFGIS) was developed to monitor the nature of changing surface conditions in select urban basins. High-risk scenarios were used to describe the potential for future flooding in each city. (Hirschboeck-LA State U)
W91-12637

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1990.
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12643

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990. VOLUME 1A: NORTHEAST FLORIDA - SURFACE WATER.
Geological Survey, Altamonte Springs, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12644

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990, VOLUME 1. SOUTHERN GREAT BASIN FROM MEXICAN BORDER TO MONO LAKE BASIN, AND PACIFIC SLOPE BASINS FROM TIJUANA RIVER TO SANTA MARIA RIVER.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12645

WATER RESOURCES DATA FOR INDIANA, WATER YEAR 1990.
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12646

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1989. VOLUME 1: EASTERN NEW YORK EXCLUDING LONG ISLAND.
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12647

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990. VOLUME 4: NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE TO OREGON STATE LINE.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12648

SELECTED DATA FOR STREAM SUBBASINS IN THE WATONWAN RIVER BASIN, SOUTH-CENTRAL, MINNESOTA.
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12651

SELECTED DATA FOR STREAM SUBBASINS IN THE LE SUEUR RIVER BASIN, SOUTH-CENTRAL, MINNESOTA.
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12652

U.S. GEOLOGICAL SURVEY: NORTH CAROLINA'S WATER RESOURCES--A PARTNERSHIP WITH STATE, FEDERAL, AND LOCAL AGENCIES.
Geological Survey, Raleigh, NC. Water Resources Div.
M. D. Winner.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-77, 1991. 8p (brochure).

Descriptors: *North Carolina, *Surface water, *Water quality, *Water resources, Groundwater.

For more than 80 years, the Federal-State Cooperative Program in North Carolina has been an effective partnership that provides timely water information for all levels of government. The cooperative program has raised awareness of State and local water problems and issues and has enhanced transfer and exchange of scientific information. The U.S. Geological Survey (USGS) conducts statewide water-resources investigations in North Carolina that include hydrologic data collection, applied research studies, and other interpretive studies. These programs are funded through cooperative agreements with the North Carolina Departments of Environment, Health, and Natural Resources; Human Resources; and Transportation, as well as more than a dozen city and county governmental agencies. The USGS also conducts special studies and data-collection programs for Federal agencies, including the Department of Defense, the U.S. Soil Conservation Service, the Tennessee Valley Authority, and the U.S. Environmental Protection Agency that contribute to North Carolina's water information data base. Highlights of selected programs are presented to show the scope of USGS activities in North Carolina and their usefulness in addressing water-resource problems. The reviewed programs include the statewide data-collection program, estuarine studies, the National Water-Quality Assessment program, military installation restoration program, and groundwater flow model-development program in the Coastal Plain and Piedmont provinces. (USGS)
W91-12653

TECHNIQUES FOR COMPUTING DISCHARGE AT FOUR NAVIGATION DAMS ON THE ILLINOIS AND DES PLAINES RIVERS IN ILLINOIS.
Geological Survey, Urbana, IL. Water Resources

Div.
D. M. Mades, L. S. Weiss, and J. R. Gray.
Available from the Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4106, 1991. 64p, 32 fig, 10 tab, 7 ref.

Descriptors: *Dams, *Discharge measurement, *Regulated flow, *Stage-discharge relations, *Streamflow, Des Plaines River, Discharge, Hydraulics, Illinois, Illinois River, Reservoir operation, Water release.

Techniques for computing discharge are developed for Brandon Road Dam on the Des Plaines River and for Dresden Island, Marseilles, and Starved Rock Dams on the Illinois River. At Brandon Road Dam, streamflow is regulated by the operation of Tainter gates and headgates. At Dresden Island, Marseilles, and Starved Rock Dams, Tainter gates are operated to regulate streamflow. Two techniques can be used to estimate discharge at the dams--gate ratings and tailwater ratings. A gate rating describes the relation between discharge, gate opening, tailwater stage and discharge. Gate ratings for Tainter gates at Dresden Island, Marseilles, and Starved Rock Dams are based on a total of 78 discharge measurements ranging from 569 to 86,400 cu ft/sec. Flood hydrographs developed using the gate ratings and Lockmaster records of gate opening and stage compared well with stream flow records published for nearby streamflow-gaging stations. Additional measurements are needed to verify gate ratings at Brandon Road Dam after rehabilitation of the dam is completed. Extensive leakage past deteriorated headgates and sluice gates contributed to uncertainty in the ratings developed for this dam. A useful tailwater rating was developed for Marseilles Dam. Tailwater ratings for Dresden Island Dam and Starved Rock Dam are of limited use because of varying downstream channel-storage conditions. A tailwater rating could not be developed for Brandon Road Dam because its tailwater pool is substantially affected by the headwater pool of Dresden Island Dam. (USGS)
W91-12655

DANUBE DELTA GENESIS, EVOLUTION AND SEDIMENTOLOGY.
Institute of Geology and Geophysics, Bucharest (Romania).
For primary bibliographic entry see Field 2J.
W91-12843

WATER CIRCULATION OF THE DANUBE DELTA--ECOLOGICAL AND ECONOMIC SIGNIFICANCE (DER WASSERUMLAUF IM DONAUDELTA--OKOLOGISCHE UND WIRTHSCHAFTLICHE BEDEUTUNG).
Institutul de Geografie, Bucharest (Romania).
P. Gastescu, and B. Driga.
Revue Roumaine de Geologie Geophysique et Geographie: Geographie, Vol. 33, p 37-41, 1989. 1 fig, 1 tab, 7 ref. French summary.

Descriptors: *Danube Delta, *Deltas, *Ecology, *Path of pollutants, *Water circulation, *Water quality trends, Channels, Lakes, Sedimentation, Stream discharge, Streamflow.

The geographic conditions of the Danube delta increase the importance of water circulation, especially for the low-lying areas in the interior of the delta. The quantity of matter and energy displaced by the water in the network of streams and channels assures a degree of aquatic renewal in the lake basins. This is an indispensable ecological condition for deltaic biological processes. Using data from the period 1960-1982, the Matita/Merhei Lake complex, one of the most important still functioning under a quasi-natural hydrologic regime, was analyzed. The rate of renewal of 1 L/second/hectare is considered sufficient to ensure adequate water quality. Because of water-quality deterioration, several changes to, and restorations of, the inflow and discharge functions of the stream and channel network were proposed. (Author's abstract)
W91-12844

SOME PROBLEMS CONCERNING THE GENESIS, CLASSIFICATION AND USE OF SOILS IN THE DANUBE DELTA.
Kumm Industries, Inc., Phoenix, AZ.
I. Munteanu, G. Curelariu, M. Munteanu, and M. Toti.
Revue Roumaine de Geologie Geophysique et Geographie: Geographie, Vol. 33, p 43-51, 1989. 4 fig, 1 tab, 15 ref.

Descriptors: *Alluvial deposits, *Danube Delta, *Deltas, *Flood effects, *Land use, *Soil classification, *Soil genesis, Marine sediments, Organic matter, Peat soils, Sandy soils, Sedimentation, Sedimentation rates, Soil erosion, Soil management, Soil types, Sulfides, Wind erosion.

Flooding waters each year cover the land of the Danube Delta for 2-11 months, depositing alluvia and organic remnants in the Danube Delta at a rate of about 7 million metric tons/year. The depositions of new alluvia bring about a quasi-continuous interruption of the soil-forming process on the fluvial banks adjacent to the main branches, especially in the fluvial delta. The central, eastern and southern parts of the Danube Delta, covered by reed, are characterized by high accumulation of organic matter, with peat formation usually rich in sulfidic materials. On higher parts of the marine banks, the soil formation is influenced by the sandy texture of the deposits and wind erosion. The present soil cover in the Danube Delta mostly includes Histosols (36.2%) and Gleysols (28.1%). Also a higher percentage (16.2%) is represented by psamosols and marine sands. They are followed by limnosols (9.1%) and by the Alluvosols (8.4%). A much smaller percentage is represented by solonshaks (1.8%) and light chestnut steppe soils (0.2%). The organic matter as peat and natant organic matter represents 250-300 million metric tons and may ensure not only the fertilization of poor lands within the Danube Delta, but also some large areas of agricultural land with soils affected by erosion or slightly fertile soils in the surrounding regions. The main problems with regard to the maintenance and development of the agricultural, forestry and piscicultural activity in the Danube Delta are arising both from the hydro and pedomelioration difficulties due to the soil conditions and the necessity to preserve the environmental equilibrium and the tourist and ecological value of the deltaic biome. The area suitable for intensive agricultural, forestry and piscicultural development under economically efficient conditions is estimated at only 42% of the delta (about 145,000 hectares). Agriculture production should be achieved especially by a rational management of the soil natural fertility. (Mertz-PTT)
W91-12845

FATE AND SHORT-TERM PERSISTENCE OF PERMETHRIN INSECTICIDE INJECTED IN A NORTHERN ONTARIO (CANADA) HEADWATER STREAM.
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
For primary bibliographic entry see Field 5B.
W91-12868

MACROALGAE OF A STREAM IN SOUTHEASTERN BRAZIL: COMPOSITION, SEASONAL VARIATION AND RELATION TO PHYSICAL AND CHEMICAL VARIABLES.
Universidade Estadual Paulista, Sao Jose do Rio Preto (Brazil). Dept. of Botanica.
For primary bibliographic entry see Field 2H.
W91-12890

SEASONAL MIGRATION OF SMALLMOUTH BASS IN THE EMBARRASS AND WOLF RIVERS, WISCONSIN.
Wisconsin Dept. of Natural Resources, Shawano.
R. W. Langhurst, and D. L. Schoenike.
North American Journal of Fisheries Management NAJMDP, Vol. 10, No. 2, p 224-227, Spring 1990. 1 fig, 2 tab, 13 ref.

Descriptors: *Bass, *Embarrass River, *Fish migration, *Seasonal variation, *Wisconsin, *Wolf River, Ecosystems, Water temperature.

Migration of smallmouth bass Micropterus dolomieui between summer and winter habitats was investigated from 1985 to 1987 in the Embarrass and Wolf Rivers of Wisconsin. Smallmouth bass of age 2 and older (> 200 mm, total length) migrated from the Embarrass River downstream 69-87 km to the Wolf River when the water temperature fell below 16 C in autumn. Smallmouth bass returned to the Embarrass River in April and May, and most individuals returned to the same 5-km reach of the river. Adults (age 4 and older, > 280 mm) migrated sooner than subadult fish. (Author's abstract)
W91-12893

INFLUENCE OF OPERATOR POSITION ON THE PRECISION OF MEASUREMENTS TAKEN WITH HAND-HELD VELOCITY METERS IN RIVERS.
Utah Cooperative Fishery and Wildlife Research Unit, Logan.
For primary bibliographic entry see Field 7B.
W91-12895

DETERMINATION OF RHODAMINE WT IN SURFACE WATER BY SOLID-PHASE EXTRACTION AND HPLC WITH FLUORESCENCE DETECTION.
Ministry of Transport and Public Works, Middelburg (Netherlands). Tidal Waters Div.
For primary bibliographic entry see Field 2K.
W91-12919

2F. Groundwater

SAMPLE FUNCTIONS AS INDICATORS OF AQUIFER HETEROGENEITIES.
King Abdulaziz Univ., Jeddah (Saudi Arabia).
Z. Sen, and A. Al-Baradi.
Nordic Hydrology NOHYBB, Vol. 22, No. 1, p 37-48, 1991. 15 fig, 12 ref.

Descriptors: *Aquifer characteristics, *Aquifer testing, *Groundwater movement, *Hydrologic models, *Model studies, *Pumping tests, Storativity, Temporal variation, Transmissivity.

An adaptive slope matching method was used to evaluate the aquifer heterogeneity from constant rate aquifer test data. The basic aquifer parameters such as the storativity and transmissivity are considered to vary spatially and the effects of such changes appear as temporal variations during a pumping test period. It is stressed that this is due to the depression cone expansion with time around the pumping well. The plots of individual parameters versus time are referred to as the sample functions. These functions have erratic variations indicating that the aquifers considered have local heterogeneities. A moving average technique was applied to each parameter sample function for the purpose of finding regional trends in the parameter variations. It is interesting that the arithmetic average values of sample functions yield aquifer parameter values as obtained by the classical type curve matching techniques which assume that the aquifer concerned is homogeneous. Hence the use of the sample function concept is recommended for the detailed interpretation of the aquifer heterogeneity. (Author's abstract)
W91-11659

SULPHUR AND OXYGEN ISOTOPES BEHAVIOUR IN SULPHATES OF ATMOSPHERIC GROUNDWATER SYSTEM OBSERVATIONS AND MODEL.
Marie Curie-Sklodowska Univ., Lublin (Poland).
For primary bibliographic entry see Field 5B.
W91-11660

GEOSTATISTICAL CHARACTERIZATION OF GROUNDWATER FLOW PARAMETERS IN A SIMULATED AQUIFER.
Geological Survey of Canada, Ottawa (Ontario).
A. J. Desbarats, and R. M. Srivastava.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 687-698, May 1991. 14 fig, 34 ref.

Descriptors: *Analog models, *Aquifers, *Geostatistics, *Groundwater movement, *Model studies, *Statistical methods, *Transmissivity, Anisotropy, Channels, Geohydrology, Heterogeneity, Stochastic hydrology.

An analog method was used to simulate a discrete transmissivity field free of the artifacts inherent in conventional multivariate Gaussian statistical generation methods. The simulated field provides a realistic model of a formation exhibiting the spatial continuity of extreme transmissivities which gives rise to barriers and preferential channels for groundwater flow. The heterogeneous transmissivity field and the corresponding steady-state head and discharge fields are characterized in a geostatistical framework and observed spatial statistics are compared with theoretical results from the stochastic hydrogeology literature. The simulated transmissivity field exhibits a bimodal distribution and strong directional anisotropy with nested scales of heterogeneity. Despite these significant departures from standard models, the observed head covariance and head-log-transmissivity cross-covariance agree well with theory. The spatial covariance of specific discharge is highly anisotropic reflecting preferential channeling in the mean direction of flow and the conservation of flux along streamlines. The effective transmissivity of the field is predicted more accurately by the spatial geometric average than by theoretical models despite the flow channeling and the anisotropy of heterogeneity. Results suggest that ensemble theoretical models based on perturbation approaches can provide reasonable estimates of general flow and transport properties of single field realizations under moderate conditions of heterogeneity. (Author's abstract)
W91-11722

NUMERICAL CALCULATION OF EQUIVALENT GRID BLOCK PERMEABILITY TENSORS FOR HETEROGENEOUS POROUS MEDIA.
Chevron Oil Field Research Co., La Habra, CA.
L. J. Durlofsky.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 699-708, May 1991. 9 fig, 21 ref.

Descriptors: *Flow, *Groundwater movement, *Hydraulic properties, *Model studies, *Permeability, *Porous media, *Rock properties, Boundary conditions, Finite element method, Fractal mathematics, Heterogeneity, Model validation, Numerical analysis, Simulation, Velocity.

A numerical procedure is presented for computing the effective or equivalent permeability of a region of a formation given the fine scale permeability distribution within the region. The determination of the effective or equivalent permeability of heterogeneous rock regions is important in flow simulations because the scaling up process allows for the use of fewer simulation grid blocks, resulting in computational savings. The method entails solution of the fine scale pressure equation subject to periodic boundary conditions to yield, upon appropriate averaging of the fine scale velocity field, the coarse scale or equivalent grid block permeability. When the region over which this coarse scale permeability is computed constitutes a representative elementary volume (REV), the resulting equivalent permeability may be interpreted as the effective permeability of the region. Solution of the pressure equation on the fine scale is accomplished through the application of an accurate triangle-based finite element numerical procedure, which allows for the modeling of geometrically complex features. The specification of periodic boundary conditions is shown to yield symmetric, positive definite equivalent permeability tensors in all cases. The method is verified through application to a periodic model problem and is then applied to the scale up of areal and cross sections with fractally generated permeability fields. (Author's abstract)
W91-11723

RECIPROCITY PRINCIPLE AND AN ANALYTICAL SOLUTION FOR DARCIAN FLOW IN A NETWORK.
British Geological Survey, Wallingford (England).
J. A. Barker.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 743-746, May 1991. 1 fig, 1 tab, 5 ref.

Descriptors: *Darcys law, *Drawdown, *Ficks Law, *Groundwater movement, *Pumping tests, *Reciprocity principle, Laplace equation, Mathematical equations, Model validation, Pumping, Well hydraulics, Wells.

For Darcian flow in an arbitrary network of heterogeneous branches, it was determined that the drawdown at node m due to pumping at node n is identical to that at node n with the same pumping at node m, provided the condition on any boundary is either zero-flow or zero-drawdown. Equations were developed that provide a method for evaluating the drawdown at any point in a network of homogeneous branches at any time by numerical inversion of the Laplace transform. The results of a demonstration problem show that, for a moderately large network, this Laplace transform solution can be evaluated with an accuracy well beyond that expected from a discretized numerical model, so one use of it would be to verify numerical network models. The practical importance of the reciprocity principle lies in the following: (1) pumping tests with just two wells cannot provide a unique interpretation in a heterogeneous system; and (2) for a set of wells there is little point in testing in both directions between every pair, so the pumping wells can be chosen for convenience. Darcian flow is mathematically equivalent to Fickian diffusion, so all of the results described apply equally to the latter process. (Doria-PTT)
W91-11727

ANALYTICAL SOLUTIONS FOR ONE-DIMENSIONAL, TRANSIENT INFILTRATION TOWARD THE WATER TABLE IN HOMOGENEOUS AND LAYERED SOILS.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2G.
W91-11729

ANALYTICAL SOLUTION TO RICHARDS' EQUATION FOR TIME-VARYING INFILTRATION.
Arizona Univ., Tucson. Dept. of Soil and Water Science.
For primary bibliographic entry see Field 2G.
W91-11730

PRESSURIZED STEADY STATE FLOWS FROM HORIZONTAL CYLINDRICAL CAVITIES.
Auckland Univ. (New Zealand). School of Engineering.
For primary bibliographic entry see Field 2G.
W91-11733

MODELING THREE-DIMENSIONAL FLOW ABOUT ELLIPSOIDAL INHOMOGENEITIES WITH APPLICATION TO FLOW TO A GRAVEL-PACKED WELL AND FLOW THROUGH LENS-SHAPED INHOMOGENEITIES.
GeoTrans, Inc., Harvard, MA.
C. R. Fitts.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 815-824, May 1991. 16 fig, 17 ref.

Descriptors: *Flow around objects, *Flow characteristics, *Flow models, *Gravel packing, *Groundwater movement, *Model studies, *Well hydraulics, Boundaries, Computer programs, Differential equations, Laplace equation, Path of pollutants, Pressure head, Simulation, Steady flow, Uniform flow.

Analytical functions are superimposed to model three-dimensional steady groundwater flow in regions containing one or more inhomogeneities shaped like prolate or oblate ellipsoids of revolution. Each function and the sum of such functions are solutions of Laplace's equation, the governing differential equation for steady groundwater flow. The functions are implemented in a manner that provides exact continuity of flow across the entire boundary of each inhomogeneity. In general, continuity of head is provided at specified control points on the boundary and is approximated between control points. For the case of one inhomogeneity in a uniform flow field, it turns out that there is exact continuity of head across the entire surface of the inhomogeneity. A computer program was developed to implement the method. Two applications include: (1) flow to a gravel-packed well, and (2) flow through a series of lens-shaped inhomogeneities. These examples demonstrate that the approximation of continuity of head can be made acceptable for many problems. A possible application of the technique would be testing various theories regarding contaminant migration and dispersion by stimulating flow and chemical diffusion through large numbers of lens-shaped inhomogeneities. (Author's abstract)
W91-11735

TWO-DIMENSIONAL MODELING OF ADVECTION-DOMINATED SOLUTE TRANSPORT IN GROUNDWATER BY THE MATCHED ARTIFICIAL DISPERSIVITY METHOD.
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W91-11740

ESTIMATION OF PARAMETERS FOR FREQUENCY DOMAIN MODELS.
Wright State Univ., Dayton, OH. Dept. of Geological Science.
R. W. Ritzi, S. Sorooshian, and V. K. Gupta.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 873-882, May 1991. 9 fig, 2 tab, 20 ref.

Descriptors: *Frequency analysis, *Geohydrology, *Groundwater movement, *Model studies, *Parameter estimation, *Statistical models, Atmospheric pressure, Calibrations, Error analysis, Estimating, Parameterization.

The problem of estimating parameters for frequency domain models is well known. Past approaches have most commonly used estimation criteria based upon either the modulus or phase transformation of the frequency response functions of the model and the observed data. As an alternative, a complex vector estimator can be posed and can be optimized within the context of a Gauss-Marquardt algorithm. A comparison of the complex vector estimator and the phase estimators was made. The case of estimating the parameters of a model for well response to atmospheric pressure variation and the solid Earth tide was considered since the uniqueness and identifiability issues for this case have been addressed previously. The results show that the complex vector estimation criterion is superior in that it has less bias and variance and is more robust. For the case where errors in the data are normally distributed and do not violate the implicit assumptions of the complex vector estimator, the resulting error in the parameter estimator is normally distributed. An alternate approach would be to mix both the modulus and the phase representations within one estimation criterion. (Doria-PTT)
W91-11741

ESTIMATION OF FLUID FLOW PROPERTIES FROM THE RESPONSE OF WATER LEVELS IN WELLS TO THE COMBINED ATMOSPHERIC AND EARTH TIDE FORCES.
Wright State Univ., Dayton, OH. Dept. of Geological Science.
R. W. Ritzi, S. Sorooshian, and P. A. Hsieh.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 883-893, May 1991. 14 fig, 18 ref, append.

Descriptors: *Atmospheric pressure, *Fluid flow, *Groundwater movement, *Tidal effects, *Water level, *Well hydraulics, Algorithms, Confined aquifers, Correlation analysis, Hydraulic models, Parameter estimation, Storativity, Transmissivity.

The water level in an open well tapping a confined formation is influenced by natural forces including the solid Earth tide (SET) and atmospheric pressure variation (APV). The spectral method is used to analytically derive a model for well response to both random and periodic components of the combined SET and APV forcings (CSA). An inverse theory and algorithm are developed in order to provide improved results when using the model to estimate the hydraulic parameters associated with a given formation. An examination of the response surface of the estimation criterion reveals a uniqueness problem in estimating storativity (S). Since there is little correlation between the transmissivity (T) and S estimators, a good estimate for T is still possible independent of having accurate knowledge of S. An estimate of T is possible only if the data contain sufficient information so that the analysis occurs within an identifiability window. The CSA estimation methodology was compared to individual SET and APV schemes. The CSA scheme gave the greatest probability that sufficient information is contained in a data record so that T is indeed identifiable. The results of applications to synthetic data indicate that the CSA scheme gives a T estimate with the most precision and also that it requires collecting fewer observations. These results are of practical importance when designing data collection procedures. (Author's abstract)
W91-11742

LARGE-SCALE NATURAL GRADIENT TRACER TEST IN SAND AND GRAVEL, CAPE COD, MASSACHUSETTS: I. EXPERIMENTAL DESIGN AND OBSERVED TRACER MOVEMENT.
Geological Survey, Marlborough, MA.
D. R. LeBlanc, S. P. Garabedian, K. M. Hess, L. W. Gelhar, and R. D. Quadri.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 895-910, May 1991. 14 fig, 3 tab, 50 ref. NSF Grants 83117865-ECE and CESS-8814615.

Descriptors: *Cape Cod, *Data acquisition, *Experimental design, *Gravel, *Groundwater movement, *Massachusetts, *Path of pollutants, *Sand, *Solute transport, *Tracers, Aquifers, Bromides, Camp Borden Site, Dispersion, Geohydrology, Heterogeneity, Lithium, Molybdenum, Ontario, Precipitation, Sampling, Sediments, Sorption.

A large-scale natural gradient tracer experiment was conducted on Cape Cod, Massachusetts, to examine the transport an dispersion of solutes in a sand and gravel aquifer. The nonreactive tracer, bromide, and the reactive tracers, lithium and molybdate, were injected as a pulse in July 1985 and monitored in three dimensions as they moved as far as 280 m down-gradient through an array of multilevel samplers. The bromide cloud moved horizontally at a rage of 0.42 m per day. It also moved downward about 4 m because of density-induced sinking early in the test and accretion of areal recharge from precipitation. After 200 m of transport, the bromide cloud had spread more than 80 m in the direction of flow, but was only 14 m wide and 4-5 m thick. The lithium and molybdate clouds followed the same path as the bromide cloud, but their rates of movement were retarded about 50% relative to bromide movement because of sorption onto the sediments. The general behavior of the tracer cloud was similar to that reported at the Borden (Ontario) site. The features of the cloud were also similar to those reported in several field studies of much larger contaminant plumes. Despite the inherent complexity of the concentration distributions in the tracer cloud, which was the result of aquifer heterogeneity, the general behavior of the cloud, seen in maps and in the spatial movements, was predictable from a careful analysis of the geohydrologic system. (See also W91-11744) (Doria-PTT)
W91-11743

LARGE-SCALE NATURAL GRADIENT TRACER TEST IN SAND AND GRAVEL, CAPE COD, MASSACHUSETTS. II. ANALYSIS OF SPATIAL MOMENTS FOR A NONREACTIVE TRACER.
Geological Survey, Marlborough, MA. Water Resources Div.
S. P. Garabedian, D. R. LeBlanc, L. W. Gelhar, and M. A. Celia.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 911-924, May 1991. 13 fig, 2 tab, 37 ref. NSF Grants 8311786-ECE and CES-8814615.

Descriptors: *Cape Cod, *Gravel, *Groundwater movement, *Massachusetts, *Path of pollutants, *Sand, *Solute transport, *Tracers, Aquifers, Bromides, Camp Borden Site, Dispersivity, Groundwater transport, Hydraulic conductivity, Hydraulic gradient, Lithium, Molybdenum, Ontario, Porosity.

A large-scale natural gradient tracer test was conducted to examine the transport of reactive and nonreactive tracers in a sand and gravel aquifer on Cape Cod, Massachusetts. As part of this test, the transport of bromide, a nonreactive tracer, was monitored for about 280 m and quantified using spatial moments. The calculated mass of bromide for each sampling date varied between 85% and 105% of the injected mass using an estimated porosity of 0.39, and the center of mass moved at a nearly constant horizontal velocity of 0.42 m per day. A nonlinear change in the bromide longitudinal variance was observed during the first 26 m of travel distance, but afterward the variance followed a linear trend, indicating the longitudinal dispersivity had reached a constant value of 0.96 m. The transverse dispersivities were much smaller; transverse horizontal dispersivity was 1.8 cm, and transverse vertical dispersivity was about 1.5 mm. The horizontal displacement of the bromide cloud was accurately predicted using estimates of hydraulic conductivity, porosity, and hydraulic gradient. A comparison of results from tracer tests at the Borden site (Ontario) and Cape Cod site shows uniform velocity of the nonreactive solute, similar values of longitudinal dispersivity, and small values of transverse dispersivity for both sites. Results show that, although nonreactive solute concentrations are highly variable and difficult to predict on a small scale, the average characteristics (i.e., spatial moment) can be predicted accurately. (See also W91-11743) (Doria-PTT)
W91-11744

SAMPLING DESIGN FOR GROUNDWATER SOLUTE TRANSPORT: TESTS OF METHODS AND ANALYSIS OF CAPE COD TRACER TEST DATA.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7B.
W91-11745

GROUND WATER IN THE ALEXANDRIA DUNE FIELD AND ITS POTENTIAL INFLUENCE ON THE ADJACENT SURF-ZONE.
Port Elizabeth Univ. (South Africa). Dept. of Botany.
E. E. Campbell, and G. C. Bate.
Water SA WASADV, Vol. 17, No. 2, p 155-160, April 1991. 8 fig, 16 ref.

Descriptors: *Aquifers, *Coastal waters, *Coasts, *Dunes, *Groundwater movement, *Nitrogen, *Nutrients, *South Africa, Ammonia, Ecosystems, Groundwater use, Nitrates, Phosphorus, Saline-freshwater interfaces, Selective withdrawal, Surf zone.

The potential for man-made damage to the surf and dune environments if water is removed from the dunes in Alexandria was investigated. Along the western 10 km of the seaward section of the Alexandria, South Africa, dune field is a series of 40 wet interdune depressions known as dune slacks. Wells were installed to a depth of approximately 1 m in one of the slacks. Salinity was measured to the nearest 1 ppt in order to determine how much the sea water diluted the nutrients measured in the groundwater. In addition, nitrate, ammonium, and phosphorus were measured. Soluble reactive phosphorus contents of the groundwater were not significantly different from that of the adjacent sea water. Ammonia levels were about twice that of surf water while nitrate levels were about ten times higher than that of the sea. On average, the groundwater enters the surf-zone at a rate of 1,000 L per running meter of beach. This results in a net flow of nitrogen from the dune groundwater to the surf-zone of 1,050 g N/a for each meter of beach. This makes the groundwater flow from the dune aquifer an important source of nitrogen for surf-zone phytoplankton, in that it replaces much of the nitrogen lost from the surf-zone ecosystem. This link represents an interdependence between these two apparently distinct ecosystems. (White-Reimer-PTT)
W91-11771

MODELING NITRATE TRANSFERS IN HYDROLOGICAL SYSTEMS (MODELISATION DU TRANSFERT DES NITRATES DANS UN SYSTEME HYDROLOGIQUE).
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 5B.
W91-11789

BOREHOLE SUMMARY REPORT FOR FIVE GROUND-WATER MONITORING WELLS CONSTRUCTED IN THE 1100 AREA.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W91-11828

EVALUATION OF WATER RESOURCES OF ORANGE AND EASTERN JEFFERSON COUNTIES, TEXAS.
Texas Water Development Board, Austin.
D. Thorkildsen, and R. Quincy.
Texas Water Development Board, Austin, Report No. 320, January 1990. 34p, 16 fig, 3 tab, 25 ref.

Descriptors: *Groundwater management, *Groundwater resources, *Saline water intrusion, *Texas, *Water demand, *Water quality, *Water resources data, *Water resources management, *Water use, Aquifers, Coastal aquifers, Consumptive use, Drawdown, Groundwater recharge, Maps, Projections, Water pollution sources, Water table decline.

An evaluation of water resources was conducted in Orange and eastern Jefferson Counties in response to the 1985 passage of House Bill 2 by the Texas Legislature, which called for the identification of study areas in the state that are experiencing, or expected to experience within the next 20 years, critical underground water problems. The study area is located on the Gulf Coastal Plain. Petrochemical and other heavy industries dominate the economy with agribusiness contributing to a smaller degree. Surface water supplies the majority of municipal and industrial demands, which make up the largest portion of total water use in the study area. Groundwater needs, including all municipal requirements in Orange County, are met almost entirely from the lower Chicot aquifer. Annual effective recharge (availability) to the Chicot aquifer is approximately 19,600 acre-ft; however, an estimated 18 million acre-ft of water is held in storage within the aquifer system. Large groundwater withdrawals have caused water level declines of as much as 40 ft, which have resulted in a slight amount of land surface subsidence (generally less than 0.5 ft). Since the late 1970's and 80's pumpage has decreased, resulting in water level rises over most of the study area. The main groundwater quality problem is elevated chloride concentrations caused by saline-water encroachment in areas of concentrated pumpage, although from the late 1970's to 1988, chloride concentrations have not changed significantly due to decreased groundwater withdrawal. In 1985, total water use in the study area was about 243,643 acre-ft, of which 92% was for municipal and industrial purposes. Projected demands are expected to reach 325,713 acre-ft/yr by 2010. Available surface water supplies (1,570,000 acre-ft/yr) are adequate to meet all surface-water needs through the planning period; however, groundwater demand is likely to exceed the annual effective recharge by 1990. Although groundwater in storage within the aquifer is sufficient to meet future demands, heavy pumpage in concentrated areas would result in significant water level declines, which could cause

saline-water encroachment and possible subsidence problems. Therefore, future groundwater development programs will require careful planning in order to avoid a recurrence of historical groundwater problems. (Author's abstract)
W91-11834

EVALUATION OF WATER RESOURCES IN PART OF NORTH-CENTRAL TEXAS.
Texas Water Development Board, Austin.
B. Baker, G. Duffin, R. Flores, and T. Lynch.
Texas Water Development Board, Austin, Report No. 318, January 1990. 67p, 19 fig, 3 tab, 93 ref.

Descriptors: *Groundwater resources, *Texas, *Water use, Aquifers, Consumptive use, Drawdown, Groundwater management, Groundwater recharge, Maps, Oil fields, Projections, Water demand, Water pollution sources, Water quality, Water resources management, Water table decline.

Water resources within the North-Carolina Texas Region which lies in the Brazos, Red, Sulphur, Sabine, and Trinity River basins, were evaluated. The geologic formations underlying the study area range in age from Paleozoic to Recent. The principal water-bearing formations are the Antlers, Twin Mountains, and Paluxy Formations of the Trinity Group, and the Woodbine Group, all of Cretaceous age. In 1985, about 110,000 acre-ft of groundwater was pumped from all aquifers in the study area, with about 47,000 acre-ft or 42% of the total pumped for public supply (towns with populations of 1,000 or more). An additional 35,000 acre-ft (or 32%) was pumped to supply the needs of communities of less than 1,000 population and rural domestic uses. Extensive cones of depression have developed in the piezometric surface of each of the region's principal aquifers, coinciding with areas of large groundwater withdrawals. During the 13-year period 1976 to 1989, water level declines of 25 ft (1.9 ft/yr) were common in the aquifers studied. The study identified a number of existing and potential water quality problems. Some of these are naturally occurring and are related to geologic structure. Elevated levels of some chemical constituents suggest contamination related to oil-field activities and other industrial sources. The projected water demands for the study area by the year 2010 total over 1.4 million acre-ft. Existing surface-water reservoirs can supply 1.6 million acre-ft of water under 2010 conditions. Most of this water, however, is either currently owned by or under contract to supply current and future needs in the study area. An additional 179,000 acre-ft of surface water will become available with the completion of the Cooper Reservoir and completion of the delivery system from Lake Palestine. The amount of groundwater currently pumped exceeds the estimated annual effective recharge to the area's aquifers; a portion of the water pumped is drawn from aquifer storage resulting in water level declines. Even though the study area has sufficient surface water to meet projected needs through 2010, rural areas that depend on a groundwater supply could face shortages before 2010 due to the limited availability of groundwater and the high cost of converting to a surface water supply. (See also W91-11838) (Author's abstract)
W91-11836

EVALUATION OF WATER RESOURCES IN PART OF CENTRAL TEXAS.
Texas Water Development Board, Austin.
B. Baker, G. Duffin, R. Flores, and T. Lynch.
Texas Water Development Board, Austin, Report No. 319, January 1990. 67p, 21 fig, 3 tab, 84 ref.

Descriptors: *Groundwater resources, *Texas, *Water use, Aquifers, Consumptive use, Drawdown, Groundwater management, Groundwater recharge, Maps, Oil fields, Projections, Water demand, Water pollution sources, Water quality, Water resources management, Water table decline.

Water resources in the Brazos, Red, Colorado, and Trinity River basins, in Central Texas, were evaluated. In 1985 there was a little less than 81,000 acre-ft of groundwater pumped from all aquifers in the study area, with a little less than 77,000 acre-ft of groundwater pumped from the Trinity Group aquifer. Irrigation accounted for about 56% of all groundwater pumped. A serious problem associated with the development of groundwater from the Trinity Group aquifer is the decline of artesian pressure in areas of large groundwater withdrawals. A regional cone of depression exists in McLennan County centered around the Waco area. Degradation of groundwater within the Antlers and Travis Peak Formations from oil-field brines and organic material are problems in several counties. The deterioration of water quality for the City of Blum has occurred over a 26-year period and is associated with water level declines in the Hensell Member of the Travis Peak Formation. The Woodbine Group yields good quality water at or near the outcrop; however, the residual sodium carbonate and percent sodium limit its use for irrigation, while high iron and fluoride content restricts its use for public supply. The projected water demands for the area by the year 2010 total over 287,700 acre-ft. Existing surface reservoirs in the study area alone can supply 296,400 acre-ft of water under 2010 conditions. Nearly all of this water is either currently owned or under contract to supply current and future needs. An additional 176,000 acre-ft of surface water could become available with the development of the proposed Lake Bosque and Paluxy Reservoir projects and with reallocation of storage in existing Lakes Waco and Whitney. The amount of groundwater currently pumped exceeds the estimated annual effective recharge to the Trinity Group aquifer; the groundwater supply for the area will continue to be drawn from storage within the aquifer. Although most areas in the study area have sufficient surface water to meet projected municipal and manufacturing needs through 2010, localized shortages could occur by 1990 largely due to limited availability from the Trinity Group aquifer. (See also W91-11836) (Author's abstract)
W91-11838

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, SEPTEMBER 1989.
For primary bibliographic entry see Field 7C.
W91-11839

HYDROLOGIC DATA OF THE NASHUA AND SOUHEGAN RIVER BASINS, MASSACHUSETTS.
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-11840

HYDROGEOLOGY AND WATER QUALITY OF THE TUG HILL GLACIAL AQUIFER IN NORTHERN NEW YORK.
Geological Survey, Ithaca, NY.
T. S. Miller, D. A. Sherwood, and M. M. Krebs.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225. USGS Water Resources Investigations Report 88-4014, 1989. 17 fig, 9 tab, 38 ref, 4 plates.

Descriptors: *Aquifer characteristics, *Geohydrology, *Groundwater quality, *Groundwater resources, *New York, *Tug Hill Aquifer, Aquifer systems, Groundwater movement, Groundwater recharge, Infiltration, Seepage.

The Tug Hill aquifer, in northern New York, is a 47-mile-long, 0.25-to-3.5-mile-wide, crescent-shaped Pleistocene sand and/or gravel deposit. The northern and central parts of the aquifer are under water-table conditions; the southern part has both water-table and discontinuous confined conditions. Groundwater and streams in the northern and central parts flow westward; those in the southern part flow from the edges of the valley to West Branch Fish Creek, which flows southeastward along the center of the valley. Principal sources of aquifer recharge are (1) infiltration of precipitation on the aquifer, estimated to be 137 million gallons per day, (2) infiltration from small streams that cross the north half of the aquifer, estimated to be 4.9 million gallons per day, and (3) seepage of runoff from adjacent till and bedrock, estimated to be 11.4 million gallons per day. Groundwater discharges from the aquifer (1) by evapotranspiration, (2) through pumping, (3) as subsurface flow from the southern end of the aquifer at McConnellsville, (4) as seepage to springs, wetlands, and streams along the western margin of the central and northern parts of the aquifer, and (5) as seepage to tributary streams and West Branch Fish Creek on the valley flat. Good-quality water that is suitable for drinking and most other uses is found in most parts of the aquifer. The pH of the groundwater in the study area ranges from 5.9 to 8.0, with a median of 7.5. Water in the northern part, which is underlain by limestone, has a specific conductance and higher concentrations of hardness, alkalinity, calcium, and sulfate than water in other parts of the aquifer, which are underlain by shale, siltstone, and sandstone. Median concentrations of hardness, dissolved solids, chloride, and sulfate in the Tug Hill aquifer were less than those in six other upstate New York aquifers. (Author's abstract)
W91-11841

POTENTIOMETRIC SURFACE OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, SEPTEMBER 1989.
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11842

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, SEPTEMBER 1989.
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11843

APPROXIMATE WATER-LEVEL CHANGES IN WELLS COMPLETED IN THE CHICOT AND EVANGELINE AQUIFERS, 1977-90 AND 1989-90, AND MEASURED COMPACTION, 1973-DECEMBER 1989, IN THE HOUSTON-GALVESTON REGION, TEXAS.
Geological Survey, Houston, TX. Water Resources Div.
D. L. Barbie, L. S. Coplin, and G. L. Locke.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225. USGS Open-File Report 90-132, 1990. 7 sheets, 7 fig, 3 ref. Prepared in cooperation with the City of Houston and the Harris-Galveston Coastal Subsidence District.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Groundwater level, *Houston, *Maps, *Subsidence, *Texas, *Water level fluctuations, Groundwater management, Hydrographs, Monitoring wells, Soil compaction, Water districts.

A series of reports has been made that depict water-level changes since 1977 and compaction of subsurface material since 1973. The City of Houston, Texas, and the Harris-Galveston Coastal Subsidence District have cooperated in a report which presents approximate water-level changes in wells in the Chicot and Evangeline aquifers, 1977-90 and 1989-90, and measured compaction, 1973-December 1989, in the Houston-Galveston region. The Chicot aquifer and the underlying Evangeline aquifer are composed of discontinuous sedimentary deposits of sand, silt, and clay, which thicken to the southeast. In most of the region, the water in the aquifers is fresh. The primary basis for separating the Chicot aquifer from the underlying Evangeline aquifer is a difference in hydraulic conductivity; the hydraulic conductivity is larger in the Chicot aquifer and, in part, causes the difference in the altitude of the water levels in wells completed in the two aquifers. In the southern and eastern parts of the region, the aquifers are under artesian conditions. The water levels in the Houston-Galveston region can be considered a system of intersecting cones of depression caused by water withdrawn from numerous wells throughout the area. The maps were prepared using measurements from

342 wells, including new monitoring wells in the southern and southwestern parts of the Houston-Galveston region added to the network in 1990. Compaction of subsurface material is being measured by 13 borehole extensometers at 11 sites. (Fish-PTT)
W91-11844

SELECTED DATA DESCRIBING STREAM SUBBASINS IN THE REDWOOD RIVER BASIN, SOUTHWESTERN MINNESOTA.
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11845

POTENTIOMETRIC-SURFACE MAP OF THE GORDO AQUIFER IN NORTHEASTERN MISSISSIPPI, AUGUST THROUGH DECEMBER 1987.
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11846

HYDROGEOLOGY OF THE MIDDLE WILCOX AQUIFER SYSTEM IN MISSISSIPPI.
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11847

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN A PART OF CURRY COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
R. Cruz.
Available from New Mexico State Engineer's Offices as New Mexico Map CU-30. Prepared by the New Mexico State Engineer in cooperation with the U.S. Geological Survey. 1 map (sheet).

Descriptors: *Depletion allowance, *Groundwater depletion, *Groundwater level, *Maps, *New Mexico, Economic aspects, Groundwater potential, Groundwater recession, Taxes, Water level.

A series of maps has been prepared by the New Mexico State Engineer to be used by the U.S. Internal Revenue Service (IRS) for tax purposes. The maps show groundwater depletion allowed by the IRS for the calendar year 1989. The areas of unsaturated post-Mesozoic deposits as of January 1962 are delineated where known. In parts of the mapped area the saturated thickness has not been determined. The groundwater depletion is mapped using contour lines with a one-foot interval. In Curry County the southeastern portion was mapped (approximately 600 sq mi), and the range of groundwater depletion ranges from 0 in the north and west parts of the mapped areas to 9 ft in the southeastern section near Pleasure Lake. Several small areas of water level depression can be seen. (See W91-11851 thru W91-11853) (Fish-PTT)
W91-11850

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN CENTRAL LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
R. Cruz.
Available as New Mexico Map LC-32. Prepared by the New Mexico State Engineer in cooperation with the U.S. Geological Survey. 1 map (sheet).

Descriptors: *Depletion allowance, *Groundwater depletion, *Groundwater level, *Maps, *New Mexico, Economic aspects, Groundwater potential, Groundwater recession, Taxes, Water level.

A series of maps has been prepared by the New Mexico State Engineer to be used by the U.S. Internal Revenue Service (IRS) for tax purposes. The maps show groundwater depletion allowed by the IRS for the calendar year 1989. The areas of unsaturated post-Mesozoic deposits as of January 1962 are delineated where known. In parts of the mapped area the saturated thickness has not been determined. The groundwater depletion is mapped using contour lines with a one-foot interval. In central Lea County, the groundwater depletion is 0 in most of the mapped area, with 4 slightly depressed areas ranging from 1 to 3 ft in the northeastern section of the mapped area. (See W91-11850, W91-11852, and W91-11853) (Fish-PTT)
W91-11851

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN NORTHERN LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
R. Cruz.
Available as New Mexico Map LN-32. Prepared by the New Mexico State Engineer in cooperation with the U.S. Geological Survey. 1 map (sheet).

Descriptors: *Depletion allowance, *Groundwater depletion, *Groundwater level, *Maps, *New Mexico, Economic aspects, Groundwater potential, Groundwater recession, Taxes, Water level.

A series of maps has been prepared by the New Mexico State Engineer to be used by the U.S. Internal Revenue Service (IRS) for tax purposes. The maps show groundwater depletion allowed by the IRS for the calendar year 1989. The areas of unsaturated post-Mesozoic deposits as of January 1962 are delineated where known. In parts of the mapped area the saturated thickness has not been determined. The groundwater depletion is mapped using contour lines with a one-foot interval. In northern Lea County, unsaturated deposits predominate in the northern and western sections. In the remaining areas the groundwater depletion is 0, except in three small depressions in the south eastern section, where the depletion is as much as 2 ft. (See W91-11850, W91-11851, and W91-11853) (Fish-PTT)
W91-11852

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN PORTALES VALLEY, ROOSEVELT COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
R. Cruz.
Available as New Mexico Map RO-33. Prepared by the New Mexico State Engineer in cooperation with the U.S. Geological Survey. 1 map (sheet).

Descriptors: *Depletion allowance, *Groundwater depletion, *Groundwater level, *Maps, *New Mexico, Economic aspects, Groundwater potential, Groundwater recession, Taxes, Water level.

A series of maps has been prepared by the New Mexico State Engineer to be used by the U.S. Internal Revenue Service (IRS) for tax purposes. The maps show groundwater depletion allowed by the IRS for the calendar year 1989. The areas of unsaturated post-Mesozoic deposits as of January 1962 are delineated where known. In parts of the mapped area the saturated thickness has not been determined. The groundwater depletion is mapped using contour lines with a one-foot interval. In Portales Valley in Roosevelt County, there are several broad areas of depression in the western and eastern parts of the valley that are mapped, ranging from 2 ft in the west to 4 ft in the east. A majority of the valley has experienced no groundwater recession. (See W91-11850 thru W91-11852) (Fish-PTT)
W91-11853

BIOPLUME (BIODEGRADATION IN AQUIFERS AND DEVELOPING A MATHEMATICAL MODEL) FOR CONTAMINANT TRANSPORT AFFECTED BY OXYGEN LIMITED BIODEGRADATION.
Rice Univ., Houston, TX. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-11855

GROUND-WATER HYDROLOGY OF PAHVANT VALLEY AND ADJACENT AREAS.
Geological Survey, Salt Lake City, UT. Water Resources Div.
W. F. Holmes, and S. A. Thiros.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Utah Department of Natural Resources, Salt Lake City, Technical Publication No. 98, 1991. 64p, 31 fig, 2 tab, 39 ref.

Descriptors: *Groundwater movement, *Groundwater resources, *Model studies, *Water quality, *Water resources data, Discharge, Hydrographs, Potentiometric level, Recharge.

The primary groundwater reservoir in Pahvant Valley and adjacent areas of Utah, is in the unconsolidated basin fill and interbedded basalt. Recharge in 1959 was estimated to be about 70,000 acre-ft/yr and was mostly by seepage from streams, canals, and unconsumed irrigation water and by infiltration of precipitation. Discharge in 1959 was estimated to be about 109,000 acre-ft and was mostly from springs, evapotranspiration, and wells. Water level declines of 50 ft occurred between 1953 and 1980 in some areas because of less-than-normal precipitation and extensive pumping for irrigation. Water levels recovered most of these declines between 1983 and 1986 because of reduced withdrawals and record quantities of precipitation. The quality of groundwater in the area west of Kanosh has deteriorated since large groundwater withdrawals began in about 1953. The cause of the deterioration is probably movement of poor quality water into the area from the southwest and possibly the west during periods of large groundwater withdrawals and recycling of irrigation water. Water level declines of more than 80 ft in some parts of Pahvant Valley are projected if groundwater withdrawals continue for 20 years at the 1977 rate of 96,000 acre-ft. Rises of as much as 58 ft and declines of as much as 47 ft are projected with withdrawals of 48,000 acre-ft/yr, for 20 years. The elimination of recharge from the Central Utah Canal is projected to cause water level declines of up to 8 ft near the canal. (USGS)
W91-11857

HYDROLOGIC EFFECTS OF WELL-FIELD OPERATIONS IN A WETLAND, DADE COUNTY, FLORIDA.
Geological Survey, Miami, FL. Water Resources Div.
R. S. Sonenshein, and R. H. Hofstetter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4143, 1990. 16p, 13 fig, 1 tab, 18 ref.

Descriptors: *Florida, *Surface-groundwater relations, *Water level fluctuations, *Wetlands, Dade County, Discharge, Everglades, Northwest Well Field, Pumpage, Rainfall.

Water level, canal stage and discharge, and rainfall data collected in a wetland in Dade County, Florida, were analyzed to determine the effects of pumping at the Northwest Well Field on water levels in the wetlands. The Northwest Well Field is the first major well field in south Florida to be operated in a wetland, away from saltwater intrusion and the potential for contamination caused by urbanization. Duration curves were used to analyze trends in water levels for seven observation wells near the Northwest Well Field. One observation well is 5.5 mi north of the well field, three wells are outside the cone of depression of the well field, and three are within the cone of depression. The water level data were analyzed for four time periods that were determined by a double-mass analysis of cumulative rainfall and cumulative canal discharge. Before 1984, water levels in all seven wells were above land surface 25 to 50% of the time. Since the well field began operating in 1984, water levels in the three wells within the cone of depression have been above land surface less than 1% of the time. Water levels at the four wells outside the cone of depression showed no effect from pumping at the well field. Water levels have declined in 30% of the 65-sq mi study area

since the well field began operating. In 15% of the area, water levels have been lowered below land surface. (USGS)
W91-11858

GEOHYDROLOGY AND CHEMICAL QUALITY OF GROUND WATER, SAN BERNARDINO NATIONAL WILDLIFE REFUGE, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
S. A. Longsworth.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4190, 1991. 28p, 8 fig, 4 tab, 18 ref.

Descriptors: *Arizona, *Geohydrology, *Groundwater resources, *San Bernardino National Wildlife Refuge, *Water quality, *Water resources data, *Wetlands, San Bernardino Valley.

In 1982, the San Bernardino National Wildlife Refuge was established in San Bernardino Valley, Arizona, to protect unique wetlands habitat for fish and wildlife and an endangered species of fish--the Yaqui topminnow. Black Draw, the main surface-water drainage in the valley, is perennial near the international boundary with Mexico. Ten wells and at least four springs are connected with the wetlands. Wetlands restoration was begun in response to habitat damage caused by cattle grazing and land clearing for farming. Interlayered alluvium and basalt flows compose the principal aquifer system in the valley. Groundwater flows from recharge areas near mountain fronts toward the basin center and then southward. Discharges from flowing wells and springs contribute water to the wetlands in the refuge. Fluctuations in groundwater levels and well discharges reflect variations in climatic conditions. Irrigation in the valley is minimal, and groundwater levels have remained stable since the mid-1950's. Discharges from flowing wells were measured during 1983-88. Annual discharge from the flowing wells totals about 400 acre-ft. Groundwater in the study area is of acceptable chemical quality for most uses and does not contain concentrations of constituents that exceed State of Arizona water quality standards. Only small quantities of groundwater are withdrawn near the refuge. The effects of groundwater withdrawals in Mexico on well-discharge rates in the refuge are not known, but continued development could affect groundwater conditions. (USGS)
W91-11859

HYDROGEOLOGY AND PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR CONTAMINATION OF THE MEMPHIS AQUIFER IN THE MEMPHIS AREA, TENNESSEE.
Geological Survey, Memphis, TN. Water Resources Div.
W. S. Parks.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4092, 1990. 39p, 2 fig, 6 tab, 4 pl, 44 ref.

Descriptors: *Confined aquifers, *Confining beds, *Geohydrology, *Groundwater pollution, *Leakage, *Memphis, *Path of pollutants, *Tennessee, *Unconfined aquifers, Potentiometric level, Water table.

Detailed maps of the thickness of the Jackson-upper Claiborne confining unit, Memphis, Tennessee and the altitude of the water table in the alluvium and fluvial deposits provide much new information concerning areas where downward leakage is or may be occurring from the water table aquifers to the Memphis aquifer. A detailed map of the altitude of the potentiometric surface of the Memphis aquifer and the location of 44 sites where contaminants have been detected in the water table aquifers indicate that many of these sites are located in areas where the direction of groundwater flow in the Memphis aquifer is toward municipal well fields. Consequently, if contaminants enter the Memphis aquifer, a hydraulic potential exists for their transport to those well fields. Recently, (1986-88), volatile organic compounds were detected in water from five municipal wells screened in the Memphis aquifer--three in the Allen well field of the Memphis Light, Gas and Water Division at Memphis and two in the west well field at Collierville. Concentrations of seven volatile organic compounds totaled about 11 microg/L in a sample from one well in the Allen well field at Memphis, and the concentration of one compound was 25 microg/L in a sample from one well at Collierville. These are the first reported occurrences of synthetic organic compounds in the Memphis aquifer and prove that the principal aquifer in the Memphis area is vulnerable to contamination. (USGS)
W91-11860

CONSTRUCTION, LITHOLOGIC, AND GEOPHYSICAL DATA FROM MONITORING WELLS IN ALBUQUERQUE, BERNALILLO COUNTY, NEW MEXICO.
Geological Survey, Albuquerque, NM. Water Resources Div.
S. F. Richey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-578, 1991. 83p, 10 fig, 19 tab, 4 ref.

Descriptors: *Albuquerque, *Borehole geophysics, *Groundwater resources, *New Mexico, *Water resources data, Bernalillo County, Lithologic logs, Monitoring, Well data.

The Santa Fe Group is the primary source of groundwater used by the city of Albuquerque, New Mexico. This aquifer, and the hydraulically connected Rio Grande alluvium, underlie land uses that could be a potential source of pollution. The Environmental Health Department of the City of Albuquerque installed 21 monitoring wells for the purposes of providing site-specific and regional groundwater quality and flow information, and detecting potential groundwater contamination associated with city-owned facilities such as landfills. Construction data, lithologic descriptions, and borehole-geophysical logs are presented for these wells. (USGS)
W91-11862

GEOHYDROLOGY AND EVALUATION OF WATER RESOURCES POTENTIAL OF THE UPPER FLORIDAN AQUIFER IN THE ALBANY AREA, SOUTHWESTERN GEORGIA.
Geological Survey, Doraville, GA. Water Resources Div.
L. J. Torak, G. S. Davis, G. A. Strain, and J. G. Herndon.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-52, 1991. 86p, 2 pl, 59 fig, 11 tab, 13 ref. Project No. 4513-09100.

Descriptors: *Finite element method, *Geohydrology, *Georgia, *Groundwater potential, *Karst hydrology, *Model studies, *Simulation, *Surface-groundwater relations, Sensitivity analysis.

In the Albany area, southwestern Georgia, the Upper Floridan aquifer lies within the Dougherty Plain district of the Coastal Plain physiographic province and consists of the Ocala Limestone of late Eocene age. A highly fractured lower water bearing zone consists of about 50 to 100 ft of alternating layers of sandy limestone and recrystallized, dolomite limestone and exhibits well-developed permeability by solution features which transmit most of the water to wells. An upper water bearing zone consists of about 60 ft of finely crystallized-to-oolitic, locally dolomitic limestone having considerably less transmissivity than the lower water bearing zone. The Upper Floridan aquifer is semi-confined by about 20 to 120 ft of undifferentiated overburden containing fine-to-coarse grained quartz sand and noncalcareous clay and confined effectively from below by the Lisbon Formation, a sandy dolomitic limestone. Wells tapping the Upper Floridan aquifer generally yield hard, calcium bicarbonate water that is suitable for most uses, and constituent concentrations do not exceed State and U.S. Environmental Protection Agency's Primary and Secondary Drinking-Water Regulations. Simulations from a two-dimensional finite-element, digital model indicate that groundwater flow is affected by regional inflow from the west, north, and east, and by outflow to the Flint River downstream from the Lake Worth dam. Pumping scenarios show that the aquifer is capable of providing at least 72 million gal/day from five locations without causing aquifer dewatering, well interfernce, or sinkhole development. Potential contamination from chemical constituents that might reside at the surface or within the overburden is small, due to confined aquifer conditions, present water quality, and rural setting. (USGS)
W91-11864

PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR ARTIFICIAL RECHARGE IN EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
D. J. Fitzpatrick.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4123, 1991. 32p, 10 fig, 3 tab, 33 ref.

Descriptors: *Arkansas, *Artificial recharge, Crowleys Ridge, Grand Prairie, Recharge basins, Recharge wells.

Pumping of water from the Mississippi River Valley alluvial aquifer in eastern Arkansas has resulted in declines in the potentiometric surface of greater than 80 ft within the area west of Crowleys Ridge and in the Grande Prairie area. Because of these declines and potential groundwater shortages, artificial recharge of the alluvial aquifer is being examined as a potential means of augmenting existing water supplies. The effectiveness of various artificial recharge technique largely depends on local geohydrologic characteristics. Artificial recharge through basins and wells is examined in detail in this investigation. The potential for recharge through basins is greatest where the upper confining unit is thin or absent, west of Crowleys Ridge along the Cache River and Village Creek. The potential for well recharge generally exists throughout the study area. Economic considerations are the major limiting factor of recharge through wells. Design criteria of an operational recharge system usually depend on site-specific conditions and local water needs. Design components for a well-recharge site include an appropriate pump, a means of pretreatment of the recharge water, a means for rehabilitating a recharge well if the well becomes clogged, and observation wells to monitor short-term and long-term clogging effects and water quality changes. Projected pumpage estimates, for the year 1990, indicate that the amount of augmentation necessary to maintain a minimum saturated thickness of 20 ft in the alluvial aquifer would require about 220 wells in the area west of Crowleys Ridge and about 500 wells in the Grand Prairie area. (USGS)
W91-11867

HYDROLOGIC AND WATER-QUALITY DATA FOR SELECTED SITES, GRAND TETON NATIONAL PARK, WYOMING, SEPTEMBER 1988 THROUGH SEPTEMBER 1990.
Geological Survey, Boise, ID.
H. W. Young, D. J. Parliman, M. L. Jones, and M. A. J. Stone.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-56, 1991. 23p, 9 fig, 1 tab, 1 ref.

Descriptors: *Drinking water, *Grand Teton National Park, *Groundwater contamination, *Groundwater resources, *Nitrogen compounds, *Water quality, *Water resources data, *Wyoming, Groundwater level, Nitrates.

This report presents hydrologic and water quality data collected from 13 observation and 10 production wells in and near Grand Teton National Park, WY. These data were collected during the period of September 1988 through September 1990. Limited pre-1988 water quality data from U.S. Geologi-

cal Survey files also are included. Hydrologic and selected water quality data collected during September 1988 were released in a report by Parliman and Young (1989). Observation wells are located near sewage-disposal ponds at Flagg Ranch, Colter Bay Village, and Signal Mountain and near a sewage drain field at Moose Village. Production wells are located near Flagg Ranch, Leeks Marina, Pilgrim Creek, Moran Junction, Jenny Lake, and Taggart Creek. Data collected at each well include depth of well, depth to water, specific conductance, pH, water temperature, and concentrations of total alkalinity, dissolved chloride, and dissolved nitrite plus nitrate as nitrogen. Water samples were collected from selected sites and were analyzed for common cations, anions, nutrients, and trace elements by the National Water Quality Laboratory in Arvada, CO. Data presented in this report are the result of a cooperative effort by the U.S. Geological Survey and the National Park Service. (USGS)
W91-11869

AQUIFER-CHARACTERISTICS AND WATER-CHEMISTRY DATA FROM WELLS ON OR NEAR NAVAJO TRIBAL LANDS IN THE ZUNI RIVER BASIN AND WHITEWATER ARROYO DRAINAGE, WEST-CENTRAL NEW MEXICO.
Geological Survey, Albuquerque, NM. Water Resources Div.
C. L. Goetz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-147, 1990. 33p, 1 fig, 3 tab, 1 pl, 11 ref.

Descriptors: *Aquifer characteristics, *Groundwater resources, *New Mexico, *Water quality, *Water resources data, Chemical analysis, Water quality standards, Wells.

Three stratigraphic units--the alluvium, the Gallup Sandstone, and the Dakota Sandstone, have favorable water bearing characteristics and are present throughout most of the Navajo tribal lands in the Zuni River basin and Whitewater Arroyo drainage, west-central New Mexico. Reported well yields are less than 10 to 500 gal/min for the alluvium aquifer; 4 to 260 gal/min for the Gallup Sandstone; and 1 to 300 gal/min for the Dakota Sandstone. Baseline diagrams of water-chemistry data for seven wells completed in the alluvium show that hardness exceeded the U.S. Environmental Protection Agency recommended drinking water standard in water from one well, and concentrations of iron and manganese exceeded the standard in water at another well. For 12 wells completed in the Gallup Sandstone concentrations of dissolved solids, hardness, sodium, sulfate, iron, and manganese exceeded the recommended standard in water from one to five wells. For 10 wells completed in the Dakota Sandstone, concentrations of dissolved solids, hardness, sodium, sulfate, iron, and manganese exceeded the recommended standard in water from two to six wells. Boron concentration, specific conductance, and sodium-adsorption ratio exceeded irrigation-water-supply criteria in water from one to eight wells for these stratigraphic units. (USGS)
W91-11870

EXTENSION OF USEPA METHOD 531 FOR THE ANALYSIS OF SEVERAL CLASSES OF NITROGENOUS PESTICIDES IN GROUNDWATER BY POSTCOLUMN UV PHOTOLYSIS.
Florida Univ., Gainesville. Pesticide Research Lab.
For primary bibliographic entry see Field 5A.
W91-11873

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990. VOLUME 5. GROUND WATER DATA FOR CALIFORNIA.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11883

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1990. VOLUME 1. MISSOURI RIVER BASIN, ARKANSAS RIVER BASIN, AND RIO GRANDE BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11884

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1990. VOLUME 2. COLORADO RIVER BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11885

WATER RESOURCES DATA FOR CONNECTICUT, WATER YEAR 1990.
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11886

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990. VOLUME 2A. SOUTH FLORIDA - SURFACE WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11887

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990, VOLUME 2B. SOUTH FLORIDA - GROUND WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11888

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990. VOLUME 4. NORTHWEST FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11889

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1990, VOLUME 1. ILLINOIS EXCEPT ILLINOIS RIVER BASIN.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11890

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1990, VOLUME 2. ILLINOIS RIVER BASIN.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11891

WATER RESOURCES DATA FOR IOWA, WATER YEAR 1990.
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11892

WATER RESOURCES DATA FOR KENTUCKY, WATER YEAR 1990.
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11893

WATER RESOURCES DATA FOR MARYLAND AND DELAWARE, WATER YEAR 1990. VOLUME 1. ATLANTIC SLOPE BASINS, DELAWARE RIVER THROUGH PATUXENT RIVER.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11894

WATER RESOURCES DATA FOR MARYLAND AND DELAWARE, WATER YEAR 1990, VOLUME 2. MONONGAHELA AND POTOMAC RIVER BASINS.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11895

WATER RESOURCES DATA FOR MICHIGAN, WATER YEAR 1990.
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11896

WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1990.
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11897

WATER RESOURCES DATA FOR NEBRASKA, WATER YEAR 1990.
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11898

WATER RESOURCES DATA FOR NEW MEXICO, WATER YEAR 1990.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11899

WATER RESOURCES DATA FOR NORTH CAROLINA, WATER YEAR 1990.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11900

WATER RESOURCES DATA FOR OHIO, WATER YEAR 1990. VOLUME 1. OHIO RIVER BASIN.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11901

WATER RESOURCES DATA FOR OHIO, WATER YEAR 1990. VOLUME 2. ST. LAWRENCE RIVER BASIN.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11902

WATER RESOURCES DATA FOR OKLAHOMA, WATER YEAR 1989.
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11903

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1990, VOLUME 2. WESTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11904

WATER RESOURCES DATA FOR VIRGINIA, WATER YEAR 1990. VOLUME 1. SURFACE

WATER AND SURFACE-WATER-QUALITY RECORDS.
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11905

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1990.
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11906

WATER RESOURCES DATA FOR WYOMING, WATER YEAR 1990.
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11907

PILOT STUDY FOR DELINEATION OF AREAS CONTRIBUTING WATER TO WELL-FIELDS AT JACKSON, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 7A.
W91-11915

WATER RESOURCES OF THE ISLAND OF KAHOOLAWE, HAWAII: PRELIMINARY FINDINGS.
Geological Survey, Honolulu, HI. Water Resources Div.
K. J. Takasaki.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4209, 1991. 17p, 4 fig, 7 ref. Project No. HI166.

Descriptors: *Groundwater resources, *Hawaii, *Phreatophytes, *Saline water intrusion, *Water resources data, Dikes, Geophysical surveys, Land use.

Initial activities in the investigation of the water resources of the island of Kahoolawe, Hawaii included the installation of gages to monitor rainfall, streamflow and groundwater levels; the construction of several water-harvesting and soil-harvesting structures; and a surface geophysical survey. The monitoring effort and the construction of water-harvesting and soil-harvesting structures began in 1988. The surface geophysical survey completed in early 1989, indicates the presence of a deep resistive body. Plans to investigate the possible groundwater impoundment by test drilling are being considered. The introduction of goats in 1788, sheep in 1858, and the phreatophyte, kiawe, in 1900 have had a significant impact on the water resources of Kahoolawe. The goats and sheep destroyed much of the vegetation cover and promoted erosion. Loss of vegetation and soil cover caused an increase in surface runoff, resulting in the decrease of groundwater recharge. The kiawe is suspected of degrading the freshwater by inducing saltwater intrusion. (USGS)
W91-11916

GEOHYDROLOGY OF THE MORRISON FORMATION IN THE WESTERN SAN JUAN BASIN, NEW MEXICO.
Geological Survey, Albuquerque, NM.
G. E. Welder, and R. L. Klausing.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4069, 1991. 1 sheet, 5 fig, 1 tab, 21 ref.

Descriptors: *Geohydrology, *Groundwater potential, *Groundwater resources, *Morrison Formation, *New Mexico, *San Juan River Basin, Water resources, Water resources data.

The Morrison Formation of Late Jurassic age underlies the San Juan Basin in northwestern New Mexico. Thickness of the Morrison is about 500 to 1,000 ft in the study area. The Morrison is composed of the Salt Wash, Recapture, Westwater Canyon, and Brushy Basin Members. The depth to the top of the Morrison ranges from less than 2,000 ft in the Four Corners platform to a maximum depth of 6,770 ft east of Farmington. The Morrison Formation consists of mudstone, claystone, siltstone, sandstone, conglomeratic sandstone, and minor limestone deposited in fluvial, eolian, and lacustrine environments. Well records and previous reports indicate that the Morrison Formation is a valuable source of groundwater on the Navajo Reservation. Groundwater recharges the aquifer system near the Chuska Mountains and the Zuni uplift and probably in the northeastern San Juan Basin. Potentiometric contours indicate that groundwater flows out of the study area to the northwest and southeast. Water is withdrawn for municipal, agricultural, and domestic uses. Water levels in large cones of depression northeast of Church Rock have been rising since uranium mines in that area closed in 1986. The Westwater Canyon Member has the greatest potential for groundwater development, and the Salt Wash and Recapture Members the least potential. Water having the smallest specific conductance is in the western and southern parts of the study area and water having the largest specific conductance is in the northeastern part of the study area. (USGS)
W91-11917

QUALITY OF WATER FROM SURFICIAL-OUTWASH AQUIFERS IN THE BIG SIOUX RIVER BASIN, EASTERN SOUTH DAKOTA.
Geological Survey, Huron, SD. Water Resources Div.
S. J. Lawrence, and S. K. Sando.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4170, 1991. 81p, 17 fig, 13 tab, 27 ref.

Descriptors: *Geochemistry, *Groundwater resources, *Water chemistry, *Water quality, Aquifers, Geohydrology, Glacial aquifers, Outwash deposits.

Approximately, 1,300 sq mi of surficial outwash deposits underlie the Big Sioux River basin of eastern South Dakota. Areal differences in the quality of water in the outwash deposits are determined largely by contact time between groundwater and limestone, dolomite, gypsum, and weathering products of those minerals rather than by differences in the mineralogy of the outwash. Water from the surficial outwash deposits in the basin has dissolved-solids concentrations ranging from 220 to 3,050 mg/L. Dominant ions in the water are calcium, magnesium, sulfate, and bicarbonate. The relation between dissolved solids and specific conductance is curvilinear because of generally large concentrations of sulfate. No relations between hydrogeology and water quality constituents were observed. Spatial relations among aquifers in the northern, central, and southern portions of the Big Sioux River also were absent. Water samples from one of the seven outwash units examined in the study had concentrations of nearly all chemical constituents that were significantly larger than those in samples from the other six outwash units. Nitrate-nitrogen concentrations in the water approached and commonly exceeded the maximum contaminant level of 10 mg/L for drinking water established by the U.S. Environmental Protection Agency. Nitrate-nitrogen concentrations were found to be related inversely to several major cations and anions. (USGS)
W91-11918

GEOLOGIC SETTING AND WATER QUALITY OF SELECTED BASINS IN THE ACTIVE COAL-MINING AREAS OF OHIO, 1987-88.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11919

PRELIMINARY REPORT ON THE HYDROGEOLOGY OF LAKE FIVE-O AND VICINITY.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2H.
W91-11920

SUMMARY OF HYDROGEOLOGIC, WATER-QUALITY, AND BIOLOGIC DATA FROM TWO SMALL BASINS, SOUTHEAST HILLSBOROUGH COUNTY, FLORIDA.
Geological Survey, Tampa, FL. Water Resources Div.
T. H. Thompson, and P. A. Metz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-395, 1990. 34p, 9 fig, 16 tab, 10 ref.

Descriptors: *Data collections, *Florida, *Mining effects, *Phosphate mining, *Water quality, Biological samples.

As part of a study to determine the hydrologic changes that might result from mining and reclamation, hydrologic, geologic, and biologic data were collected at two sites in southeast Hillsborough County, Florida, between July 1983 and September 1986. Data were collected at the test basin at the Big Four mine before mining began and following partial reclamation. Data also were collected at a nearby, unmined basin at the Lonesome mine. A summary of the data, which includes rainfall, streamflow, groundwater levels, geologic data, physical and chemical data on soils, surface water and groundwater quality, and biologic data, is presented. (USGS)
W91-11925

HYDROLOGIC DATA FOR THE JEMEZ MOUNTAINS, NEW MEXICO.
Geological Survey, Albuquerque, NM.
C. G. Abeyta, and B. M. Delaney.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-176, 1991. 51p, 3 fig, 2 pl, 2 tab, 13 ref.

Descriptors: *Geothermal studies, *Jemez Mountains, *New Mexico, Groundwater, Surface water, Water quality.

The Jemez Mountains volcanic complex in north-central New Mexico is an area of geothermal-energy exploration. This report is part of a study by the U.S. Geological Survey of the Jemez geothermal hydrologic system. Hydrologic data for the area were retrieved from the Survey's National Water-Data Storage and Retrieval (WATSTORE) System. Summaries of the availability of peak-flow, water quality, and daily-values data for 100 surface water sites and summaries of the availability of water level and water quality data for 294 groundwater sites are presented. (USGS)
W91-11926

WATER RESOURCES ACTIVITIES IN FLORIDA, 1990-91.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-11928

GEOHYDROLOGIC FRAMEWORK AND AN ANALYSIS OF A WELL-PLUGGING PROGRAM, LEE COUNTY, FLORIDA.
Geological Survey, Fort Meyers, FL. Water Resources Div.
H. R. LaRose.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4063, 1990. 26p, 10 fig, 1 pl, 1 tab, 14 ref.

Descriptors: *Florida, *Geohydrology, *Saline water intrusion, *Water pollution control, *Well plugging, Aquifers, Groundwater, Lee County, Water quality.

Many deep artesian wells were drilled in southwest Florida before the 1970's. The wells were usually completed with only a short length of casing

through the unconsolidated sediments near land surface and used mainly for agricultural irrigation purposes. Water from these deep artesian wells with short casings exceeded drinking water standards of 250 mg/L chloride concentration. Over the years, land use changed from agricultural to residential, and consequently, the demand for potable water increased. To meet the demand, many wells were drilled into shallow, freshwater bearing surficial and intermediate aquifer systems. Saline water from deep artesian wells with short casings flowed up the uncased wellbores and entered the overlying freshwater aquifers, causing saline-water intrusion. In places, chloride concentrations in water from the freshwater aquifers increased from about 100 to 250 mg/L. To abate the saline-water intrusion problem in Lee County, the South Florida Water Management District began a program, in August 1979, of plugging deep artesian wells with short or corroded casings. Results indicate a slight decrease in chloride concentrations on a local scale. (USGS)
W91-11930

HYDROGEOLOGY AND QUALITY OF GROUND WATER IN THE BOONE FORMATION AND COTTER DOLOMITE IN KARST TERRAIN OF NORTHWESTERN BOONE COUNTY, ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11931

GEOHYDROLOGY AND THE OCCURRENCE OF VOLATILE ORGANIC COMPOUNDS IN GROUND WATER, CULPEPER BASIN OF PRINCE WILLIAM COUNTY, VIRGINIA.
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11932

GROUND-WATER HYDROLOGY AND QUALITY IN THE VALLEY AND RIDGE AND BLUE RIDGE PHYSIOGRAPHIC PROVINCES OF CLARKE COUNTY, VIRGINIA.
Geological Survey, Richmond, VA. Water Resources Div.
W. G. Wright.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4134, 1990. 61p, 21 fig, 5 tab, 30 ref, append.

Descriptors: *Carbonate rocks, *Geohydrology, *Groundwater, *Groundwater quality, *Karst hydrology, *Metamorphic rocks, *Virginia, *Water quality, Shenandoah Valley, Springs.

In the carbonate rocks of the Valley and Ridge physiographic province in Clarke County, Virginia, groundwater flows along solution-enlarged fractures oriented parallel to the axes of the anticlines and synclines, along bedding-plane partings adjacent to and parallel to the bedding of the rocks, and across the bedding of the rocks following cross-strike faults and fractures. Groundwater in the Blue Ridge physiographic province in Clark County flows primarily along irregular fracture patterns in the rocks. Steep terrain in the Blue Ridge facilitates percolation of shallow groundwater through the overburden and rapid movement to springs, streams, and the Shenandoah River. Many large springs are present in the Valley and Ridge part of the county. Hydrographs of discharges from springs and water levels in a well indicate the effects of seasonal evapotranspiration on groundwater recharge and discharge. Groundwater tracers injected into sinkholes were detected in springs as far as 2 miles away within 5 months after injection. High-yielding wells in Clarke County do not necessarily correlate with the well's proximity to lineaments. A water table contour map for the county is presented. Chemical analyses of samples from wells and springs indicate that: (1) groundwater in the Valley and Ridge province of the county has greater concentrations of dissolved constituents than groundwater in the Blue Ridge province; (2) groundwater in the Valley and Ridge province is moderately hard to very hard because of high concentrations of dissolved calcium and magnesium; and (3) groundwater quality throughout much of Clarke County has been affected by moderate contamination from human activities, which is indicated by elevated concentrations of nitrate, chloride, sodium, and fecal bacteria, and one report of a pesticide in low concentration in water from a spring. (USGS)
W91-11933

METHOD TO ESTIMATE CANAL LEAKAGE TO THE BISCAYNE AQUIFER, DADE COUNTY, FLORIDA.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-11934

GROUND-WATER LEVELS AND TRITIUM CONCENTRATIONS AT THE MAXEY FLATS LOW-LEVEL RADIOACTIVE WASTE DISPOSAL SITE NEAR MOREHEAD, KENTUCKY, JUNE 1984 TO APRIL 1989.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11936

GEOHYDROLOGIC, GROUND-WATER QUALITY, AND STREAMFLOW DATA FOR THE STRATIFIED-DRIFT AQUIFERS IN THE LOWER MERRIMACK AND COASTAL RIVER BASINS, SOUTHEASTERN NEW HAMPSHIRE.
Geological Survey, Bow, NH. Water Resources Div.
S. M. Flanagan, and P. J. Stekl.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-390, March 1991. 130p, 3 fig, 8 tab, 33 ref.

Descriptors: *Geohydrology, *Groundwater quality, *New Hampshire, *Stratified aquifers, *Streamflow data, *Water resources data, Lower Merrimack River Basin.

This report presents geohydrologic data, including stratigraphic logs, well yields, groundwater quality, and stream discharge measurements collected for a study of stratified-drift aquifers located within the lower Merrimack and coastal river basins in southeastern New Hampshire. The study was conducted from October 1985 to October 1988 in cooperation with the State of New Hampshire Department of Environmental Services, Water Resources Division. The data include information on 1,232 inventory sites, 66 exploration boreholes drilled for this study, and grain-size analyses of 61 split-spoon sediment samples. Groundwater level measurements were recorded at 33 observation wells drilled for the project. Water quality analyses are presented for 24 observation and 6 municipal wells. Water quality parameters measured in the field include temperature, specific conductance, dissolved oxygen, and pH. Samples were analyzed in the laboratory for nutrients, common anions and cations, and selected volatile organic compounds. Streamflow data are presented for 16 sites. Plates at 1:48,000 scale show locations of data-collection sites. (USGS)
W91-11938

CHEMICALS AND ISOTOPIC DATA FOR WATER FROM WELLS, SPRINGS, AND STREAMS IN CARBONATE-ROCK TERRAIN OF SOUTHERN AND EASTERN NEVADA, 1985-88.
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 2K.
W91-11939

HYDROLOGIC DATA FOR THE BIG SPRING BASIN, CLAYTON COUNTY, IOWA, WATER YEAR 1989.
Geological Survey, Iowa City, IA. Water Resources Div.
S. J. Kalkhoff, and R. L. Kuzniar.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-63, 1991. 66p, 15 fig, 25 tab, 19 ref.

Descriptors: *Herbicides, *Hydrologic data, *Iowa, *Nonpoint pollution sources, *Water quality, *Water resources data, Groundwater, Surface water.

Hydrologic data were collected in the Big Spring Basin located in Clayton County, Iowa, during the 1989 water year. The data were collected in cooperation with the Iowa Department of Natural Resources, Geological Survey Bureau, to provide information on variation and movement of agricultural chemicals in the hydrologic cycle in the Big Spring Basin. Precipitation, stream, and groundwater data were collected. Total rainfall in the basin ranged from 20.0 to 24.4 inches. The greatest monthly rainfall was in August. Calcium and sulfate were the predominant ions in the rain and the median nitrate and ammonia concentrations as nitrogen were 0.40 and 0.63 mg/L, respectively. Stream discharge, water temperature, specific conductance, and pH were monitored continuously, and monthly water-quality samples were collected at three sites in the basin. The predominant ions in Roberts Creek, at the site where it leaves the basin, were calcium, magnesium, and bicarbonate. Nitrate plus nitrite as nitrogen concentrations ranged from 0.2 to 6.2 mg/L. Pesticide concentrations in 23 samples ranged from less than 0.10 micgro/L to 4.4 microg/L. Atrazine was detected in 100% of the samples, cyanazine and metolachlor in 43% of the samples and alachlor in 35% of the samples. At Big Spring, the groundwater discharge point, the daily mean water temperature ranged from 5.1 to 10.6 C, the daily mean specific conductance ranged from 271 to 793 microsiemens/cm at 26 C, and the daily pH ranged from 6.5 to 7.1 (USGS)
W91-11943

GEOHYDROLOGY AND GROUND-WATER FLOW SIMULATION OF THE SURPRISE SPRING BASIN AQUIFER SYSTEM, SAN BERNARDINO COUNTY, CALIFORNIA.
Geological Survey, Sacramento, CA. Water Resources Div.
C. J. Londquist, and P. Martin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4099, 1991. 23p, 20 fig, 6 tab, 17 ref.

Descriptors: *California, *Geohydrology, *Groundwater movement, *Model studies, *San Bernardino County, *Simulation, *Springs, Geologic fractures, Transpiration.

The Surprise Spring basin is the main source of water for the Twentynine Palms U.S. Marine Corps Base. The groundwater system consists of an upper unit of unconsolidated sand of relatively high permeability, and a lower unit of consolidated to partly consolidated sand, silt, and clay of low permeability. There are numerous faults in the area, many of which act as barriers to groundwater movement. Recharge to the basin occurs as inflow across the western boundary. Prior to 1953, groundwater was discharged from the basin by transpiration of mesquite, discharge of Surprise Spring, and as outflow across Surprise Spring fault. Soon after pumping began in 1953, the spring stopped flowing, and by 1985 almost all of the mesquite had died. From 1953 through 1985, approximately 66,500 acre-ft of groundwater was pumped from the basin, causing groundwater declines as great as 100 ft near Surprise Spring. A groundwater flow model, developed for the basin, indicates that by 1985 about 97% of the water being pumped had been withdrawn from storage. Two model simulations based on a projected 2.1 million gallons/day increases in pumpage from 1985 to 2035 were made. If all the projected pumpage increase is from the present supply wells, the maximum water level decline would be about 154 ft near Surprise Spring. However, if the projected pumpage increase is from three proposed wells,

northwest of the supply wells, the maximum water level decline would be about 80 ft near the new wells and only about 55 ft near the spring. (USGS)
W91-11945

GEOHYDROLOGIC EVALUATION OF THE UPPER PART OF THE MESAVERDE GROUP, NORTHWESTERN COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 4C.
W91-11949

HYDROLOGIC DATA FOR THE WELDON SPRING CHEMICAL PLANT SITE AND VICINITY PROPERTY, ST. CHARLES COUNTY, MISSOURI--1986-89.
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11950

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE SUWANNEE RIVER WATER MANAGEMENT DISTRICT.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11951

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT.
Geological Survey, Tallahassee, FL. Water Resources Div.
P. E. Meadows.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-586, 1991. 1 sheet, 1 fig.

Descriptors: *Florida, *Groundwater level, *Potentiometric level, *Upper Floridan Aquifer.

The May 1990 potentiometric-surface map of the Upper Floridan aquifer in northwest Florida depicts groundwater levels for the annual low water level period. Water levels in May 1990 were about 1 to 2 ft lower than May 1985 levels in the eastern area and near the same to slightly higher than May 1985 in the western area of northwest Florida. The water level declines in the eastern area from May 1985 to May 1990 may have been the result of below normal cumulative rainfall. The rise in water levels in the western areas may have been due to above average rainfall during the early spring of 1990. (USGS)
W91-11952

LYSIMETER STUDY OF NITROGEN FERTILIZER AND IRRIGATION RATES ON QUALITY OF RECHARGE WATER AND CORN YIELD.
North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W91-11996

BIOLOGICAL STATE OF GROUND WATERS IN THE ZLATICA-PIRDOP BASIN.
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5B.
W91-12063

FINITE DIFFERENCE MODELLING OF THE VARIATION IN PIEZOMETRIC HEAD WITHIN A ROCKFILL EMBANKMENT.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-12086

GROUND WATER FLOW PATHS IN RELATION TO NITROGEN CHEMISTRY IN THE NEAR-STREAM ZONE.
York Univ., Toronto (Ontario). Dept. of Geography.
A. R. Hill.
Hydrobiologia HYDRB8, Vol. 206, No. 1, p 39-52, October 15, 1990. 9 fig, 21 ref.

Descriptors: *Groundwater movement, *Nitrates, *Nitrogen, *Surface-groundwater relations, *Water chemistry, *Wetlands, Ammonia, Chlorides, Dissolved oxygen, Geochemistry, Groundwater quality, Ontario, Organic soils.

Interactions between groundwater flow paths and water chemistry were studied in the riparian zone of a small headwater catchment near Toronto, Ontario. Significant variations in 18-O and chloride indicated the presence of distinct sources of water in the groundwater flow system entering the near-stream zone. Shallow groundwater at the upland perimeter of the riparian zone had concentrations of nitrate-N (100-180 microgm/L), chloride (1.2-1.8 mg/L), and dissolved oxygen (4.6-9.1 mg/L). Concentrations of nitrate-N in deep groundwater flowing upward beneath the riparian wetland were <10 micrograms/L, whereas chloride ranged between 0.6-0.9 mg/L and dissolved oxygen ranged between 0.4-2.2 mg/L. Ammonium-N concentrations (20-60 micrograms/L) were similar in both shallow and deep groundwater. Groundwater was transported through the wetland to the stream by three hydrologic pathways: (1) shallow groundwater emerged as springs near the base of the hillslope producing surface rivulets which crossed the riparian zone to the stream; (2) deep groundwater flowed upward through organic soils and entered the rivulets within the wetland; and (3) deep groundwater reached the stream as bed and bank seepage. Springs were higher in nitrate and chloride than rivulets entering the stream, whereas bank seeps had lower concentrations of nitrate and chloride and considerably higher ammonium concentrations than the rivulets. These contrasts in nitrate and chloride concentrations were related to initial differences in the ion chemistry of shallow and deep groundwater rather than to element transformations within the riparian wetland. Differences in ammonium concentration between seeps and rivulets were caused by the immobilization of ammonium in the substrates of aerobic rivulets; little ammonium depletion occurred in deep groundwater flowing upward through reduced subsurface organic soils around the stream perimeter. (Author's abstract)
W91-12124

LITTER PROCESSING IN DIFFUSE AND CONDUIT SPRINGS.
Minnesota Univ., St. Paul. Dept. of Forest Resources.
W. Bartodziej, and J. A. Perry.
Hydrobiologia HYDRB8, Vol. 206, No. 2, p 87-97, October 22, 1990. 5 fig, 3 tab, 42 ref. University of Minnesota College of Natural Resources and Minnesota Agricultural Experiment Station Project 42-25.

Descriptors: *Decomposition, *Deterioration, *Karst hydrology, *Litter, Atrazine, Baseline studies, Decomposing organic matter, Groundwater movement, Groundwater quality, Karst, Microbial degradation, Minnesota, Nitrates, Seasonal variation, Springs.

Bedrock geology and prior water chemistry data were used to classify and choose 4 conduit and 4 diffuse flow springs in a karst region of southeast Minnesota. Decomposition processes and chemical/physical conditions were compared between spring classes during two seasons (May and September, 1987). Although large storms and conduit run-in events did not occur during sampling, baseline water chemistry supported the a priori spring classification. Baseline nitrate and atrazine levels were significantly higher in conduit than in diffuse springs. During a minor run-in event, atrazine levels increased significantly to at least 1.2 micrograms/L in all conduit systems, but remained unchanged in diffuse systems. Decay rates of the two predominant litter sources in the springs (watercress (Nasturtium officinale R. Br.) in May and box elder (Acer negundo L.) in September) were used to assess differences in biological activity between the spring classes. During May, watercress decayed (1 mm coarse mesh bags) at approximately the same rate in conduit and diffuse systems, $k=0.094$ and 0.099, respectively. This result was unexpected since shredder colonization was much greater on litter bags in diffuse systems. In September, box elder decay rate was significantly higher in diffuse ($k=0.018$) than in conduit ($k=0.013$) springs; and decay rates seemed to reflect significantly higher shredder colonization on bags in diffuse systems. Microbial activity on watercress and box elder litter, measured as electron transport system (ETS) activity, was seldom significantly different between spring classes. Also, both watercress and box elder litter decay rates for fine mesh bags (240 microns) were similar between conduit and diffuse springs, suggesting that microbial processing did not differ greatly between spring classes. In conduit springs, low shredder colonization was apparently the result of low benthic shredder densities. Shredders and other macroinvertebrates may be adversely affected by discharge fluctuations from conduit run-in events. It is suggested that during times of low flow, watercress standing stock was also an important influence on shredder abundance. (Author's abstract)
W91-12127

NONEQUILIBRIUM SORPTION OF ORGANIC CHEMICALS BY LOW ORGANIC-CARBON AQUIFER MATERIALS.
Arizona Univ., Tucson.
For primary bibliographic entry see Field 5B.
W91-12148

QUALITY OF GROUNDWATER IN BAHRAIN.
Environmental Protection Committee, P.O. Box 26909, Bahrain.
E. Raveendran, and I. M. Madany.
Science of the Total Environment STENDL, Vol. 103, No. 2/3, p 177-183, April 15, 1991. 1 fig, 3 tab, 9 ref.

Descriptors: *Bahrain, *Drinking water, Water quality, *Groundwater quality, Arid lands, Chemical analysis, Chlorides, Coastal aquifers, Groundwater data, Nitrates, Salinity, Sodium, Sulfates.

The State of Bahrain comprises an archipelago of 33 low-lying islands and receives irregular and scanty rainfall. Groundwater is the only source of fresh water supply, and the aquifer recharge rate is low. The quality of groundwater and house tap water throughout the State of Bahrain was investigated with respect to pH, salinity, conductivity, bicarbonate, chloride, sulfate, sodium, potassium, magnesium, calcium, nitrite, nitrate, ammonia and phosphate. The groundwater showed elevated levels for: salinity, 1.40-9.30 ppt; chloride, 110-4407 mg/L; sulfate, 239-1385 mg/L; sodium, 247-2165 mg/L; and magnesium, 36-313 mg/L. These values increased with distance from western Bahrain, reaching maximum values along the southeastern coastal zone. Nitrate concentrations ranged from 1.3 to 23.3 mg/L with an average value of 4.4 mg/L. Results of the study indicate a deterioration of groundwater in localized areas. In tap water, the observed water quality ranges were: salinity, 0.7-1.5 ppt; chloride, 280-750 mg/L; and sodium, 140-400 mg/L. The quality of tap water was assessed by comparing these values with WHO guidelines, and showed one area of Bahrain, Al-Akr in the southeast, had a significant deterioration in the quality of its water, with elevated levels of most parameters analyzed. This was thought to be due to land-use practices as well as the low level of groundwater. (VerNooy-PTT)
W91-12152

IN SITU BIODEGRADATION: MICROBIOLOGICAL PATTERNS IN A CONTAMINATED AQUIFER.
Cornell Univ., Ithaca, NY. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W91-12212

ANALYSIS OF A DOMESTIC WATER WELL SURVEY.

Westinghouse Environmental and Geotechnical Services, Cary, NC.
For primary bibliographic entry see Field 4B.
W91-12213

TWO-PHASE FLOW IN HETEROGENEOUS POROUS MEDIA: I. MODEL DEVELOPMENT.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5B.
W91-12222

TWO-PHASE FLOW IN HETEROGENEOUS POROUS MEDIA: II. MODEL APPLICATION.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5B.
W91-12223

GROUNDWATER CONTAMINATION AT THE KESTERSON RESERVOIR, CALIFORNIA: I. HYDROGEOLOGIC SETTING AND CONSERVATIVE SOLUTE TRANSPORT.
Lawrence Berkeley Lab., CA. Earth Sciences Div.
For primary bibliographic entry see Field 5B.
W91-12224

PORE SCALE SPATIAL ANALYSIS OF TWO IMMISCIBLE FLUIDS IN POROUS MEDIA.
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-12231

QUASI-STEADY VERTICAL TWO-PHASE FLOWS IN POROUS MEDIA.
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
For primary bibliographic entry see Field 2G.
W91-12234

THREE-DIMENSIONAL SPATIAL MOMENTS ANALYSIS OF THE BORDEN TRACER TEST.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 5B.
W91-12238

COMPARISON BETWEEN NATURAL AND FORCED GRADIENT TESTS TO DETERMINE THE VERTICAL DISTRIBUTION OF HORIZONTAL TRANSPORT PROPERTIES OF AQUIFERS.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Environmental Sciences and Energy Research.
For primary bibliographic entry see Field 5B.
W91-12244

FIELD SCALE MASS ARRIVAL OF SORPTIVE SOLUTE INTO THE GROUNDWATER.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
For primary bibliographic entry see Field 5B.
W91-12245

STOCHASTIC MODEL OF SOLUTE TRANSPORT IN GROUNDWATER: APPLICATION TO THE BORDEN, ONTARIO, TRACER TEST.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W91-12248

CONTRIBUTION TO THE BIOLOGICAL DESCRIPTION OF RELATIONS BETWEEN SURFACE AND UNDERGROUND WATERS: VULNERABILITY OF AQUIFERS TO RIVER POLLUTION (ESSAI DE DESCRIPTION BIOLOGIQUE DES INTERACTIONS ENTRE EAU DE SURFACE ET EAU SOUTERRAINE: VULNERABILITE D'UN AQUIFERE A LA POLLUTION D'UN FLEUVE).
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France). Div. Qualite des Eaux.
For primary bibliographic entry see Field 5B.
W91-12271

WATERBORNE OUTBREAK OF NORWALK VIRUS GASTROENTERITIS AT A SOUTHWEST US RESORT: ROLE OF GEOLOGICAL FORMATIONS IN CONTAMINATION OF WELL WATER.
Centers for Disease Control, Atlanta, GA. Div. of Reproductive Health.
H. W. Lawson, M. M. Braun, R. I. M. Glass, S. E. Stine, and S. S. Monroe.
Lancet LANAAI, Vol. 337, No. 8751, p 1200-1204, May 18, 1991. 2 fig, 3 tab, 14 ref.

Descriptors: *Geohydrology, *Groundwater pollution, *Path of pollutants, *Public health, *Viruses, *Well water, Drinking water, Fecal coliforms, Geologic fractures, Microbiological studies, Water treatment.

From April 17 to May 1, 1989, gastroenteritis developed in about 900 people during a visit to a new resort in Arizona. Of 240 guests surveyed, 110 had a gastrointestinal illness that was significantly associated with the drinking of tap water from the resort's well (relative risk = 16.1, 95% confidence interval 14.5 to 17.8) and this risk increased significantly with the number of glasses of water consumed ($p < 0.005$). Three of seven paired sera tested for antibodies to the Norwalk agent had a four-fold or greater rise in titre. Water contaminated with fecal coliforms was traced back to the deep water well, which remained contaminated even after prolonged pumping. Effluent from the resort's sewage treatment facility seeped through fractures in the subsurface rock (with little filtration) directly into the resort's deep wall. Although the latest technology was used to design the resort's water and sewage treatment plants, the region's unique geological conditions posed unexpected problems that may trouble developers faced with similar subsurface geological formations and arid climatic conditions in many parts of the world. In these areas, novel solutions are needed to provide adequate facilities for the treatment of sewage and supply of pure drinking water. (Author's abstract)
W91-12289

RESIDUAL DAMAGE TO HEMATOPOIETIC SYSTEM IN MICE EXPOSED TO A MIXTURE OF GROUNDWATER CONTAMINANTS.
National Toxicology Program, Research Triangle Park, NC.
For primary bibliographic entry see Field 5C.
W91-12306

EFFICIENT AND ACCURATE FRONT TRACKING FOR TWO-DIMENSIONAL GROUNDWATER FLOW MODELS.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5B.
W91-12324

ONE-DIMENSIONAL SUBSURFACE TRANSPORT OF A NONAQUEOUS PHASE LIQUID CONTAINING SPARINGLY WATER SOLUBLE ORGANICS: A FRONT-TRACKING MODEL.
California Univ., Los Angeles. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-12325

HYSTERESIS AND STATE-DEPENDENT ANISOTROPY IN MODELING UNSATURATED HILLSLOPE HYDROLOGIC PROCESSES.
Washington State Univ., Pullman. Dept. of Civil Engineering.
J. T. McCord, D. B. Stephens, and J. L. Wilson.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1501-1518, July 1991. 17 fig, 2 tab, 41 ref.

Descriptors: *Aeration zone, *Anisotropy, *Groundwater movement, *Hysteresis, *Infiltration, *Model studies, *Path of pollutants, *Slopes, *Soil water, Flow profiles, Geohydrology, Mathematical models, Simulation analysis, Soil properties.

A series of soil water tracer experiments were conducted to numerically model the flow and transport behavior observed in field experiments. These experimental and numerical results strongly suggest that current widely held views and commonly applied modeling approaches are flawed in many cases for unsaturated flow, and provide strong supporting evidence for a variable, state-dependent anisotropy in the hydraulic conductivity of an unsaturated medium. This phenomenon has been previously postulated in a number of independent theoretical and experimental investigations. In general, the previous studies identify layered heterogeneity as a primary cause of the macroscopic anisotropy. This study illustrates how hysteresis in the soil moisture characteristics can cause a texturally homogeneous porous media profile to behave anisotropically under transient unsaturated conditions. Recognizing that both of these factors (layered heterogeneity and capillary hysteresis) contribute to the anisotropic behavior observed in the tracer experiments, an attempt was made to quantify the relative magnitude of their contributions in a numerical modeling investigation. For the numerical modeling study, a finite element flow and transport code was used which introduced a simple procedure for incorporating variable anisotropy into a predictive numerical model. A diagnostic modeling approach was used to determine the relative magnitude of textural heterogeneity and capillary hysteresis as causes of the observed macroscopic anisotropy. The results of the diagnostic modeling study indicate that textural heterogeneity is by far the most important contributor to the variable macroscopic anisotropy observed at the field site. The diagnostic simulations further show that the variable anisotropy approach is well suited to modeling field-scale problems. Subsequently, a sensitivity analysis was performed to determine how climate, geologic and topographic structure, and media lithology affect flow and transport behavior when soils were specified to have a variable macroscopic anisotropy. The results of this study clearly indicate that variable state-dependent anisotropy is a real and significant process at the field site and that modeling with consideration of variable anisotropy strongly affects model predictions. (Author's abstract)
W91-12326

NONSTATIONARY SPECTRAL METHOD FOR SOLVING STOCHASTIC GROUNDWATER PROBLEMS: UNCONDITIONAL ANALYSIS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
S. G. Li, and D. McLaughlin.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1589-1605, July 1991. 7 fig, 3 tab, 46 ref, append.

Descriptors: *Geohydrology, *Groundwater movement, *Mathematical studies, *Stochastic hydrology, Differential equations, Fourier analysis, Mathematical equations, Stochastic process, Time series analysis.

Stochastic analyses of groundwater flow and transport are frequently based on partial differential equations which have random coefficients or forcing terms. Analytical methods for solving these equations rely on restrictive assumptions which may not hold in some practical applications. Numerically oriented alternatives are computationally demanding and generally not able to deal with large three-dimensional problems. A hybrid solution approach was been developed which combines classical Fourier transform concepts with numerical solution techniques; the approach is based on a nonstationary generalization of the spectral representation theorem commonly used in time series analysis. The generalized spectral representation is expressed in terms of an unknown transfer function which depends on space, time and wave number. The transfer function is found by solving a linearized deterministic partial differential equation which has the same form as the origi-

nal stochastic flow or transport equation. This approach can accommodate boundary conditions, spatially variable mean gradients, measurement conditioning, and other sources of nonstationarity which cannot be included in classical spectral methods. (Author's abstract)
W91-12334

SURFACE-SUBSURFACE WATER INTERACTIONS IN AN ALLUVIATED MOUNTAIN STREAM CHANNEL.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2E.
W91-12336

FLOW THROUGH FISSURED POROUS MEDIA WITH DEFORMABLE MATRIX: IMPLICIT FORMULATION.
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
N. Khalili-Naghadeh, and S. Valliappan.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1703-1709, July 1991. 3 fig, 4 tab, 12 ref.

Descriptors: *Geohydrology, *Geologic fractures, *Groundwater movement, *Mathematical models, *Model studies, *Porous media, Finite element method, Flow profiles, Hydrologic properties, Mathematical equations, Porosity, Pressure, Simulation analysis.

An implicitly coupled double-porosity model has been presented for simulating the behavior of deformable fissured porous media. The finite element technique was used to develop the numerical approximation of the governing equations. Using the proposed model, the effect of matrix deformation on the behavior of fissured porous media was studied. It was found that: (1) the response of a deformable fissured porous medium is identical to that of rigid formations with regard to three distinct periods of early, intermediate, and late time responses; (2) while matrix deformation can significantly contribute to the late time productivity of fissured porous media, it has very limited effect on the early time productivity; (3) during the early time response period, fluid pressure tends to rise in porous blocks before starting to fall--this is believed to be consistent with the coupling behavior of deformable fissured porous media; and (4) the fissure response of a deformable fissured porous medium may be practically simulated. (Author's abstract)
W91-12345

SIMULATION OF NON-GAUSSIAN SPACE RANDOM FUNCTIONS FOR MODELING TRANSPORT IN GROUNDWATER.
California Univ., Berkeley. Dept. of Civil Engineering.
Y. Rubin.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1711-1721, July 1991. 9 fig, 2 tab, 37 ref. UC Toxic Substances Teaching and Research Program Grant 77608 and Chevron Oil Fields Research Company Grant LH-2341.

Descriptors: *Geohydrology, *Groundwater movement, *Mathematical models, *Model studies, *Simulation analysis, Environmental tracers, Flow velocity, Geologic fractures, Hydraulic conductivity, Hydrologic properties, Mathematical studies, Porosity, Spatial variation, Stratification, Vertical flow.

The recent developments and successful applications of covariance-related stochastic methods to groundwater field experiments suggest that further efforts in developing spatial characterization methods are warranted. One area that deserves further attention is that of characterizing multimodal distributions, such as fractured rock masses, dolomite rocks with dissolution channels, and sand-shale formations. Traditionally used covariance functions may not be enough to fully characterize spatial continuity in applications where the pattern of spatial continuity depends on the specific magnitude level of the attribute, for example, hydraulic conductivity. Alternative models based on multiple indicator covariances or a mixture of populations offer greater flexibility. Applying such models to the case of perfect stratification, a stochastic simulation is proposed which allows generating different realizations, all sharing the same vertical conductivity covariance yet differing by other spatial statistics and leading to widely different transport characteristics. A mere covariance-based approach would have failed to distinguish between these alternatives. Investigation of tracer transport in bimodal stratified formations suggest a dependence of the mean advection velocity on the dispersion coefficients as a result of a mechanism that enhances longitudinal dispersion directly proportional to lateral pore scale dispersion and entails a diversion of a substantial portion of the plume into the low-conductivity layers. This mechanism may not be evident when the class-specific spatial structures of the conductivities are ignored. (See also W91-12347) (Author's abstract)
W91-12346

TRANSPORT IN HETEROGENEOUS POROUS MEDIA: PREDICTION AND UNCERTAINTY.
California Univ., Berkeley. Dept. of Civil Engineering.
Y. Rubin.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1723-1738, July 1991. 10 fig, 30 ref. DOE Contract DE-AC03-76-SF-00098 and Chevron Oil Field Research Company Contract LH-2341.

Descriptors: *Groundwater movement, *Heterogeneity, *Lagrangian model, *Mathematical models, *Model studies, *Path of pollutants, *Plumes, *Porous media, *Statistics, Mathematical studies, Particle size, Simulation analysis, Solute transport.

A method was developed to obtain risk-qualified estimates of various statistics that characterize the migration of a nonreactive tracer in heterogeneous porous media. The steps required to get these estimates are: (1) the solute body is assumed to be composed of a large number of imaginary solute particles; (2) a Lagrangian description of the migration of the solute particles in space is adopted; (3) the Lagrangian description is transformed into an Eulerian one by a quasi-linear method, whereby the translation of the particles in space is simulated through successive, spatially correlated displacements; (4) the plume's various statistics are obtained by averaging over the ensemble of simulated particles; and (5) simultaneous simulation of the motion of two particles in space entails the spatial moments of the plume and their variances, and in addition, the concentration is obtained qualified by its variance. The model is compared with numerical simulations and is found to compare quite favorably even for rlog conductivity variances as large as 2.6. This study shows that: (1) after a certain travel time, the concentration variance becomes largest next to the plume center and gets smaller with distance from the plume center; (2) the concentration coefficient of variation grows with distance from the plume center and prediction of the low concentration on the periphery of the plume is subject to the largest uncertainty; (3) the concentration coefficient of variation grows with time while the concentration variance gets smaller with time; and (4) interpretation of field data depends on the interpolation method and in particular on the size of the averaging domain. (See also W91-12346) (Author's abstract)
W91-12347

HYDROGEOLOGICAL AND ENVIRONMENTAL IMPACT OF COAL MINING, JHARIA COALFIELD, INDIA.
Indian School of Mines, Dhanbad. Dept. of Applied Geology.
For primary bibliographic entry see Field 4C.
W91-12463

EFFECT OF COAL MINE WATERS OF VARIABLE PH ON SPRINGWATER QUALITY: A CASE STUDY.
Institute of Karst Geology, Guilin (China).
For primary bibliographic entry see Field 5B.
W91-12466

CONTAMINANT MIGRATION IN IMPERFECTLY KNOWN HETEROGENEOUS GROUNDWATER SYSTEMS.
Waterloo Centre for Groundwater Research (Ontario).
For primary bibliographic entry see Field 5B.
W91-12509

FLOW AND TRANSPORT IN FRACTURED ROCKS.
Lawrence Berkeley Lab., CA. Earth Sciences Div.
J. S. Y. Wang.
Reviews of Geophysics RVGPB4, Vol. Supp, p 254-262, 1991. 213 ref. DOE Contract DE-AC03-76SF0098.

Descriptors: *Fracture permeability, *Geohydrology, *Groundwater movement, *Heterogeneity, *Literature review, Channeling, Field tests, Geologic fractures, Porosity, Porous media, Solute transport.

Laboratory-scale studies of discrete fractures lead to better understanding of the relationship between flow properties and pore geometry. Field-scale studies of fracture networks test the validity of classical continuum approaches for transport processes in heterogeneous media. During 1987 to 1990, earth scientists made significant advances in quantifying flow channeling and solute breakthrough in rough-walled fractures, analyzing transitions between fracture and matrix flows under multiphase conditions, and characterizing fracture networks with hydrological and geophysical studies. In this literature review article, the effect of heterogeneity and the issue of scaling are discussed. Many common features and similar approaches can be identified in microcracks, discrete fractures, soil macropores, fractured rock masses, and heterogeneous reservoirs at different scales. (Author's abstract)
W91-12510

HIERARCHICAL APPROACHES TO TRANSPORT IN HETEROGENEOUS POROUS MEDIA.
Nevada Univ., Reno. Desert Research Inst.
For primary bibliographic entry see Field 5B.
W91-12511

PHYSICAL MEASUREMENTS IN SUBSURFACE HYDROLOGY.
Auburn Univ., AL.
J. H. Dane, and F. J. Molz.
Reviews of Geophysics RVGPB4, Vol. Supp, p 270-279, 1991. 169 ref.

Descriptors: *Analytical methods, *Data acquisition, *Geohydrology, *Instrumentation, *Literature review, *Measuring instruments, Field tests, Hydraulic properties, Hydrologic properties, Monitoring wells, Porous media, Pumping tests, Soil properties, Tensiometry.

In many ways, the measurement of physical properties of heterogeneous subsurface materials is the central challenge of modern subsurface hydrology. Due largely to the lack of practical measurement techniques, the current ability to define parameters conceptually, often for computational purposes, has vastly outpaced methodology for measuring those parameters, especially in the field. Any physical parameter that has not been or can not be subjected to independent measurement can not be claimed to be 'real.' There are many classes of measurements within the purview of subsurface hydrology, including, in the broadest sense, all measurements related to physical, chemical and biological phenomena. In literature review paper, only those measurements needed to define the basic hydraulic properties of subsurface porous media that relate to the occurrence and movement of water are reviewed. The methods are highlighted in the following sections: (1) field procedures; (2) laboratory procedures; (3) tensiometry and pressure transducers; (4) hydraulic properties; (5) soil textures; (6) functional relationships; (7) inverse procedures; (8) direct field methods; (9) geophysics-based measurements; (10) tracer and dis-

persion measurements; (11) pumping, slug and related testing; (12) design and analysis of measurement schemes; and (13) well construction methodology. (Author's abstract)
W91-12512

MONITORING GROUNDWATER AND WELL WATER FOR CROP PROTECTION CHEMICALS.
Monsanto Co., St. Louis, MO.
For primary bibliographic entry see Field 5A.
W91-12536

SIMULTANEOUS TRANSPORT OF PARENT AND DAUGHTER COMPOUNDS IN AQUIFERS WITH LINEAR FIRST-ORDER SORPTION KINETICS.
Oregon State Univ., Corvallis. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W91-12556

SELECTING OPTIMUM DISCHARGE RATE FOR WATER WELL.
Memphis State Univ., TN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W91-12567

CHARACTERIZATION OF FRACTURE GEOMETRY UTILIZING PARTICULATE TRACERS AND BOREHOLE TEMPERATURE.
Notre Dame Univ., IN. Dept. of Civil Engineering.
S. E. Silliman, and C. C. Cady.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-195776. Price codes: A06 in paper copy, A01 in microfiche. Final Report, November 1990. 108p, 47 fig, 11 tab, 90 ref. USGS Contract No. 14-08-0001-G1477.

Descriptors: *Chemical tracers, *Geohydrology, *Geologic fractures, *Groundwater movement, *Hydraulic tests, *Tracers, Boreholes, Heat pulse flowmeter, Monte Carlo method, Particle size, Particulate matter, Sensitivity analysis, Testing.

Prediction of flow and transport in fractured media requires characterization of the major mechanisms influencing movement of water and solutes within individual fractures. Among the tests utilized to parametrize these mechanisms are hydraulic and chemical tracer tests. Results from these tests have shown that the apertures estimated from hydraulic and tracer tests do not agree. In this project, the discrepancy between these estimates was investigated through numerical analysis and field tests involving combined hydraulic and chemical tracer tests. The theoretical results led to an explanation for the observed difference between these estimates based on the degree of anisotropy in the distribution of the aperture within the plane of a fracture. Field results were obtained which were consistent with the results predicted by the theory. In addition, this work has led to improvement of several field techniques for location of fracture interconnections. Included are a thermal monitoring technique and an improved heat-pulse flowmeter. Finally, initial field results demonstrated that particulate tracers can be transported between boreholes. It was observed, however, that at the flow rates utilized (approximately 0.06 liters/second), the background concentration of particulates make analysis of field samples difficult. (USGS)
W91-12624

INNOVATIVE APPROACH TO DETERMINE RETARDATION FACTORS OF ORGANIC CONTAMINANTS IN GROUNDWATER SYSTEMS.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 5B.
W91-12626

BACTERIAL TRANSFORMATIONS OF NITRATE AND ALDICARB (TEMIK) IN ANOXIC GROUNDWATERS OF LONG ISLAND.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5B.
W91-12629

LABORATORY INVESTIGATION OF RESIDUAL LIQUID ORGANICS FROM SPILLS, LEAKS, AND THE DISPOSAL OF HAZARDOUS WASTES IN GROUNDWATER.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5E.
W91-12630

NATURE AND RATES OF BACTERIAL METABOLISM IN THE AQUIFERS OF SOUTHEASTERN LOUISIANA.
Louisiana State Univ., Baton Rouge. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5B.
W91-12636

PATHWAYS, MECHANISMS, AND RATES OF SOLUTE TRANSPORT ACROSS THE BASE OF THE FRESH WATER ZONE, SOUTH LOUISIANA.
Louisiana State Univ., Baton Rouge. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5B.
W91-12641

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1990.
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12643

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990. VOLUME 1A: NORTHEAST FLORIDA - SURFACE WATER.
Geological Survey, Altamonte Springs, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12644

WATER RESOURCES DATA FOR INDIANA, WATER YEAR 1990.
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12646

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1989. VOLUME 1: EASTERN NEW YORK EXCLUDING LONG ISLAND.
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12647

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990. VOLUME 4: NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE TO OREGON STATE LINE.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12648

U.S. GEOLOGICAL SURVEY: NORTH CAROLINA'S WATER RESOURCES--A PARTNERSHIP WITH STATE, FEDERAL, AND LOCAL AGENCIES.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-12653

DETERMINATION OF HYDRAULIC PROPERTIES IN THE VICINITY OF A LANDFILL NEAR ANTIOCH, ILLINOIS, DECEMBER 1987.
Geological Survey, Urbana, IL. Water Resources Div.
R. T. Kay, and J. D. Earle.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4124, 1990. 33p, 14 fig, 5 tab, 11 ref.

Descriptors: *Antiach Landfill Site, *Aquifer characteristics, *Confined aquifers, *Groundwater movement, *Illinois, *Landfills, *Leaky aquifers, *Water pollution sources, Diffusivity, Hazardous wastes.

An aquifer test was conducted in the vicinity of a landfill near Antioch, Illinois, in December 1987, to determine the extent of hydraulic connection between the hydrogeologic units in the area. The units consist of a shallow, unconfined, sand and gravel aquifer, an intermediate confining unit of till, and a deep confined sand and gravel aquifer that provides the water supply for the village of Antioch. The aquifer test was conducted in the confined aquifer. Aquifer-test data were analyzed using several methods. Using the Hantush and Jacob method for a leaky confined aquifer with no storage in the confining unit, calculated aquifer transmissivity ranged from 19,600 to 25,200 feet squared per day, aquifer storativity ranged from 0.00021 to 0.000871, leakage through the confining unit ranged from 0.000129 to 0.000784 foot per day per foot, and hydraulic conductivity of the confining unit ranged from 0.00322 to 0.0192 foot per day. Transmissivity and storage in the confining unit are in good agreement with the values calculated from the Hantush and Jacob method. Confining unit diffusivity, estimated using the ratio method, ranged from 50.36 to 68.13 feet squared per day. The aquifer-test data clearly showed that the confining unit was hydraulically connected to the deep aquifer. Analysis of the drawdown in the confining unit indicates that hydraulic connection with the unconfined aquifer would be induced within 24 hours of pumping the confined aquifer. (USGS)
W91-12656

GROUND-WATER CONTAMINATION AND MOVEMENT AT THE DEFENSE GENERAL SUPPLY CENTER, RICHMOND, VIRGINIA.
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-12658

ESTIMATES OF HYDRAULIC CONDUCTIVITY FROM AQUIFER-TEST ANALYSES AND SPECIFIC-CAPACITY DATA, GULF COAST REGIONAL AQUIFER SYSTEMS, SOUTH-CENTRAL UNITED STATES.
Geological Survey, Austin, TX. Water Resources Div.
D. E. Prudic.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4121, 1991. 38p, 15 fig, 7 tab, 28 ref.

Descriptors: *Coastal aquifers, *Geohydrology, *Groundwater movement, *Gulf Coast Aquifer System, *Regional Aquifer System Analysis, Aquifer characteristics, Permeability coefficient, Specific capacity, Statistical analysis.

Hydraulic conductivities were estimated from more than 1,500 aquifer test analyses and more than 5,000 specific capacity data from wells drilled into tertiary and younger sediments of the Gulf Coastal Plain in the south-central United States. Values for hydraulic conductivity, which are assumed to represent the coarser grained sediments, range from less than 1 ft/day to more than 1,000 ft/day. The values are log normally distributed; thus, the geometric mean was used to represent a typical hydraulic conductivity. The geometric mean hydraulic conductivity for the entire study area was 55 ft/day from aquifer test analyses and 71 ft/day from specific capacity data. Results of a two way analysis of variance indicate that area, layer, and the interaction of area and layer were all

significant in explaining the variation of hydraulic conductivity at a probability level of 0.001. The highest geometric mean generally was in model layer 11, which corresponds to the upper Pleistocene and younger deposits along the coast of the Gulf of Mexico and the alluvium of the Mississippi River. Within each model layer, the geometric mean increased from areas along the western part of the study area to the eastern part. Results of an analyses of covariance indicate that depth to the middle of the perforated or screened interval was significant at the probability level of 0.02 and that sand bed thickness was not significant at the probability of 0.10. In the analysis with depth, hydraulic conductivity decreased as a function of depth in most of the area and layer combinations. (USGS)
W91-12659

GULF COAST REGIONAL AQUIFER-SYSTEM ANALYSIS--A KENTUCKY PERSPECTIVE.
Geological Survey, Austin, TX. Water Resources Div.
H. F. Grubb, and J. K. Arthur.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4138, 1991. 28p, 15 fig, 1 tab, 27 ref.

Descriptors: *Geohydrology, *Groundwater movement, *Gulf Coast Aquifer System, *Regional Aquifer System Analysis, Drawdown, Groundwater budget, Groundwater depletion, Groundwater potential, Groundwater recharge, Pumpage.

The Gulf Coast Regional Aquifer-System Analysis is a study of regional aquifers in sediments of mostly Cenozoic age in a 230,000 sq mi area of the Coastal Plain of the south-central United States. The Mississippi embayment aquifer system, one of three identified in the study area, is the only one present in Kentucky. About 1% of the total area underlain by the aquifer system is in eight western Kentucky counties. Groundwater pumpage from the aquifer system in Kentucky has increased by a factor of about 3, from 4 to 12 million gal/day, during the period 1960-85. Pumpage has caused an increase in recharge to aquifers in Kentucky and an increase in aquifer outflow to adjacent States. The effects of pumping additional quantities of water from the aquifer system in Kentucky were investigated using a digital groundwater flow model. Expected effects are: substantial lowering of the potentiometric surface, decreasing discharge in the pumped aquifers, lowering potentiometric surfaces of overlying aquifers, increasing total recharge, and reducing aquifer outflow to adjacent States. Pumping an additional 10 million gal/day from the middle Claiborne aquifer at each of three sites would cause: (1) a predevelopment discharge area of substantial size to become part of the recharge area; (2) an increase in the area having 4 in/yr recharge; and (3) a lowering of the potentiometric surface by more than 20 ft. Additional pumpage of 10 million gal/day from the lower Wilcox aquifer near Clinton, Kentucky, would have substantial impact on the potentiometric surfaces of aquifers and the vertical flow between aquifers, but minimal impact on size of recharge and discharge areas. The potentiometric surface of the pumped aquifer would be lowered about 330 ft at the pumping center. (USGS)
W91-12661

EFFECTS OF GEOTHERMAL GROUNDWATER ON NUTRIENT DYNAMICS OF A LOW-LAND COSTA RICAN STREAM.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
C. M. Pringle, and F. J. Triska.
Ecology ECOLAR, Vol. 72, No. 3, p 951-965, June 1991. 11 fig, 2 tab, 47 ref. NSF Grant BSR-87-17746.

Descriptors: *Costa Rica, *Geothermal water, *Groundwater discharge, *Nutrients, *Pantano River, *Salto River, *Streamflow, *Surface-groundwater relations, Algae, Bioassay, Periphyton, Phosphorus, Water quality.

Spatial and temporal variability of surface and groundwater nutrient chemistry was contrasted between two tributaries of the Salto River, which drain the terminus of Pleistocene lava flows in the Atlantic slope foothills of Barva Volcano, Costa Rica. Some riparian zones along the Salto are saturated by subsurface inflows of phosphorus-rich, geothermal groundwater of the sodium-chloride-bicarbonate type. The heterogeneous pattern of solute-rich groundwater inflows results in dramatic differences in soluble reactive phosphorus (SRP) concentration between stream waters of two closely adjacent tributaries. SRP levels also vary dramatically in the water table and in soils across stream riparian zones on a scale of meters. The Salto River (SRP 50-200 microgm/L) receives steady phosphorus-rich groundwater inflows that become diluted with increasing precipitation. The Pantano lacks these inputs and retains a low background SRP concentration (typically < 10 microgm/L). SRP levels in waters of the Salto were strongly negatively correlated with discharge, while in the Pantano there was no correlation. In situ nutrient bioassays of algal periphyton growth indicated that both nitrate and SRP were at growth-saturating levels in the Salto while, in the Pantano, algal growth was phosphorus limited. The Pantano had a high retention capacity for phosphorus as measured through a whole-stream tracer injection experiment. SRP concentration was reduced by 17 and 94% of injected phosphate over 40 m and 800 m reaches, respectively. Results indicate the important linkage between geothermal activity and hydrogeochemical features of the volcanic landscape and their role in regulating ecological processes in these streams. (Author's abstract)
W91-12805

HYDROCHEMISTRY ON THE YILGARN BLOCK, WESTERN AUSTRALIA: FERROLYSIS AND MINERALIZATION IN ACIDIC BRINES.
University Coll., London (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 2K.
W91-12815

ELUTION PROFILES OF THREE CHLORINATED HYDROCARBONS LEACHING THROUGH SANDY SOIL.
Illinois Univ. at Chicago Circle. School of Public Health.
For primary bibliographic entry see Field 5B.
W91-12817

LYSIMETER STUDIES.
Schering Agrochemicals Ltd., Essex (England).
For primary bibliographic entry see Field 5B.
W91-12871

SENSITIVITY ANALYSIS OF A MATHEMATICAL MODEL FOR PESTICIDE LEACHING TO GROUNDWATER.
Winand Staring Centre for Integrated Land, Soil and Water Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 5B.
W91-12872

2G. Water In Soils

SIMULATION OF EVAPOTRANSPIRATION BY TREES.
Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Forestry and Forest Products.
For primary bibliographic entry see Field 2D.
W91-11602

IRRIGATION UNIFORMITY OF LEVEL BASINS AS INFLUENCED BY VARIATIONS IN SOIL WATER CONTENT AND SURFACE ELEVATION.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 3F.
W91-11610

SIMULATION OF IRRIGATION REQUIREMENTS FOR MAJOR CROPS IN SOUTH WESTERN QUEBEC.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W91-11647

TEST OF GUIDELINES FOR FIELD ESTIMATES OF WATER RETENTION PROPERTIES OF SOILS DERIVED FROM VOLCANIC MATERIALS IN NORTHERN TANZANIA.
Agriculture Canada, Ottawa (Ontario). Land Resource Research Centre.
J. A. McKeague, C. Wang, G. J. Ross, and W. K. Modestus.
Canadian Journal of Soil Science CJSSAR, Vol. 71, No. 1, p 1-10, January/February 1991. 2 fig, 3 tab, 17 ref.

Descriptors: *Available water, *Soil porosity, *Soil water, *Soil water retention, *Tanzania, *Volcanic soils, Clays, Field tests, Soil properties, Soil types.

Soil water properties were estimated in the field, using guidelines established in Canada, for five volcanic-derived soils in Tanzania. Many of the estimates for horizons near the surface were satisfactory but those for water retained at -1500 kPa by horizons below a depth of 1 m were far too low. These low estimates combined with underestimates of air porosity at -10 kPa for many of the samples resulted in very poor estimates of available water capacity. The guidelines were not directly applicable for estimating water properties of most of the soils studied. The samples had bulk densities of 0.9-1.3 Mg/cu m, air porosities at -10 kPa ranging from 3 to 27%, and available water capacities of 280-116 mm to depths of 140 cm or to a petrocalcic layer. X-ray analysis indicated weakly crystalline clays in all of the soils. Tiron extracted from 7 to 38% of the material from the <2 mm samples tested but the amounts of extracted material were not closely related to anomalously high water retention values at -1500 kPa. Specific surface areas, but not clay contents, of these samples were significantly related to their measured water retention values at -1500 kPa. A high proportion of porous particles in the silt fraction of a sample from a depth of 2 m in one soil indicated that highly porous non-clay sized material may account, in part, for the anomalous water retention and specific surface data. The effect of wetting and drying on the water retention properties of these soils may be important but remains to be clarified. (Author's abstract)
W91-11652

BIOLOGICAL PROCESSES IN TWO BEECH FOREST SOILS TREATED WITH SIMULATED ACID RAIN: A LABORATORY EXPERIMENT WITH ISOTOMA TIGRINA (INSECTA, COLLEMBOLA).
Goettingen Univ. (Germany, F.R.). Zoologisches Inst. und Museum.
For primary bibliographic entry see Field 5C.
W91-11662

ANALYTICAL SOLUTIONS FOR ONE-DIMENSIONAL, TRANSIENT INFILTRATION TOWARD THE WATER TABLE IN HOMOGENEOUS AND LAYERED SOILS.
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
R. Srivastava, and T. C. J. Yeh.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 753-762, May 1991. 9 fig, 15 ref. EPA Grant R-813899-01-1.

Descriptors: *Infiltration, *Mathematical studies, *Soil water, *Unsaturated flow, *Water pressure, *Water table, Boundary conditions, Drainage, Heterogeneity, Hydraulic conductivity, Hydraulics, Numerical analysis, Porous media, Pressure head, Richards equation, Soil types, Temporal distribution, Wetting.

Analytical solutions to the Richards equation for unsaturated flow under various boundary and initial conditions are difficult to obtain because of the nonlinearity in soil hydraulic parameters. This difficulty is exaggerated in the case where soil is heterogeneous. Generally, one must rely on numerical approaches for predicting moisture movement in unsaturated soils, even for homogeneous soils. However, numerical approaches often suffer from convergence and mass balance problems. Therefore, it is desirable to develop analytical solutions for moisture flow in unsaturated porous media. Analytical solutions were derived that describe the transient soil water pressure distributions during one-dimensional vertical infiltration toward the water table through homogeneous and two-layer soils. Exponential functional forms are used to represent the hydraulic conductivity and pressure relation and the soil water release curve. Steady state profiles are used as initial conditions. Hydraulic behavior of the soils during wetting and drainage processes are related to the pressure head and moisture content profiles and temporal variation of the specific discharge. The solutions provide a reliable means of comparing the accuracy of various numerical methods, especially in very dry layered soils. (Doria-PTT)
W91-11729

ANALYTICAL SOLUTION TO RICHARDS' EQUATION FOR TIME-VARYING INFILTRATION.
Arizona Univ., Tucson. Dept. of Soil and Water Science.
A. W. Warrick, A. Islas, and D. O. Lomen.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 763-766, May 1991. 2 fig, 7 ref. Western Regional Research Project W-155.

Descriptors: *Hydraulics, *Infiltration, *Infiltration rate, *Mathematical studies, *Richards equation, *Soil water, Boundary conditions, Diffusivity, Distribution, Flow, Profiles.

Analytical solutions to Richards equation have been presented for steady infiltration rates (including zero). In the present work, those results were extended for surface input expressed as a series of constant rates stepped over arbitrary time intervals. The infiltration rates must be specified as piecewise constants with time. The answer is expressed as a sum of two terms, the first of which is a function of the instantaneous infiltration and the second an integral that accounts for the water distribution within the profile for the previous infiltration history. The solutions assume specific forms for the soil water diffusivity and hydraulic functions used earlier by Broadbridge and White. Results add to the analytical solutions available for the Richards equation. Any initial condition can be included as well as arbitrary surface infiltration rates. Extensions to other hydraulic functions or type of boundary conditions are unlikely, although additional problems for a bounded profile and two-phase flow may be amenable to the same general techniques. (Doria-PTT)
W91-11730

BIOPHYSICAL SURFACE ENERGY BUDGET ANALYSIS OF SOIL TEMPERATURE IN THE BOREAL FORESTS OF INTERIOR ALASKA.
National Center for Atmospheric Research, Boulder, CO.
G. B. Bonan.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 767-781, May 1991. 16 fig, 11 tab, 79 ref.

Descriptors: *Alaska, *Energy, *Forest soils, *Soil temperature, *Soil-water-plant relationships, Albedo, Biomass, Canopy, Drainage, Elevation, Evaporation, Forests, Leaves, Model studies, Model testing, Mosses, Permafrost, Sensitivity analysis, Slopes, Snowmelt, Snowpack, Solar radiation, Temperature gradient, Trees.

Observed soil degree-days (SDD) for 20 forest stands in the discontinuous permafrost zone of interior Alaska range from 483 to 2,217. These sites range from cold permafrost soils to warm, permafrost-free soils and vary in terms of canopy height, tree biomass, elevation, slope, aspect, soil drainage, moss cover, and humus thickness. A biophysical model that solves the surface energy budget of a multilayer forest canopy was used to examine which sites were most important in controlling the observed soil temperature gradient. Simulated soil temperature averaged 851 SDD for the 20 sites. Sensitivity analyses indicated that this average could vary by 0-88 SDD (0-10% of the mean) because of possible parameter error. Removing the forest canopy and the moss cover caused the soil to warm, on average, by 408 and 345 SDD, respectively. Elevation and soil drainage differences among sites were of secondary importance, causing SDD to deviate by 71 and 66 SDD, respectively. Slope and aspect had little effect on soil temperature. Simulated site characteristics were consistent with a variety of data on solar radiation, albedo, snowpack accumulation and snowmelt, foliage water potential, and evaporation. While these tests do not fully validate the model, they indicate that it is representative of the conditions likely to be found in the forests of interior Alaska. (Doria-PTT)
W91-11731

PRESSURIZED STEADY STATE FLOWS FROM HORIZONTAL CYLINDRICAL CAVITIES.
Auckland Univ. (New Zealand). School of Engineering.
A. J. Pullan, and R. H. Hannaford.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 797-801, May 1991. 6 fig, 4 ref.

Descriptors: *Flow characteristics, *Hydrostatic pressure, *Porous media, *Pressure head, *Soil water, *Steady flow, *Unsaturated flow, Finite element method, Gravity flow, High pressure, Injection, Saturated flow.

Although recognized as important, a mathematical study of the flow of water under pressure from a supply surface of nonzero dimensions into an initially unsaturated porous medium has received relatively little attention. The coupled saturated-unsaturated flow that results from a horizontal pressurized water-filled cylindrical cavity was studied, under the assumption of quasilinearization for the unsaturated flow, using a combined boundary element-finite element method. Earlier work in this problem considered infiltration under hydrostatic pressure alone. That work is extended by the inclusion of an additional pressure head in the cavity. Detailed results were calculated for a range of pressure heads and dimensionless cavity radii, and the size of the saturated region was expressed as a function of these two parameters. Results show that even for small cavities and comparatively high pressure heads, gravity effects cannot be ignored. The calculations also reveal a linear relationship between the flux from the cavity and the applied pressure head, with the slope of this line varying approximately as the two-thirds power of the dimensionless cavity radius. (Author's abstract)
W91-11733

AUTOMATIC, REAL-TIME MONITORING OF SOIL MOISTURE IN A REMOTE FIELD AREA WITH TIME DOMAIN REFLECTOMETRY.
Geological Survey, Menlo Park, CA. Water Resources Div.
W. N. Herkelrath, S. P. Hamburg, and F. Murphy.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 857-864, May 1991. 14 fig, 13 ref.

Descriptors: *Automation, *Measuring instruments, *Monitoring, *Reflectance techniques, *Remote sensing, *Soil water, Calibrations, Field tests, Logging(Recording), New Hampshire, Standard deviation, Statistical analysis, Temperature.

A multiplex tie domain reflectometry (TDR) system for real-time monitoring of volumetric soil moisture content was developed. The system was tested at a remote field site in the Hubbard Brook Experimental Forest in New Hampshire. The average value of soil moisture content in the top 500 mm of soil was measured every 4 hours for 1 year at 12 locations within a 12-m by 18-m plot. The system functioned well except when the air temperature dropped below minus 15 C, which caused the data logger tape recorder to stop. Calibrations run on undisturbed soil cores did not compare well with published curves developed for mineral soils, probably because of high soil organic matter content. The standard error of estimate of soil moisture content, indicated by the calibrations, was 0.02 cu cm/cu cm. The standard deviation of repeated moisture content measurements made in the field was 0.003 cu c/cu cm. The effect of cable length on the TDR signal was investigated. It was found that long cables tend to attenuate the signal, ultimately making the measurement impractical. However, cable length had little effect on the calibration up to a length of 27 m. The coefficient of variation of the moisture content measurements taken at any given time ranged from 0.12 to 0.21 during the test period. As predicted by a stochastic analysis of soil moisture flow in heterogeneous soil, the spatial variability of the measurements decreased as average soil moisture increased. (Author's abstract)
W91-11739

THREE-DIMENSIONAL FIELD STUDY OF SOLUTE TRANSPORT THROUGH UNSATURATED, LAYERED, POROUS MEDIA. I. METHODOLOGY, MASS RECOVERY, AND MEAN TRANSPORT.
Agricultural Research Service, Riverside, CA. Salinity Lab.
T. R. Ellsworth, W. A. Jury, F. F. Ernst, and P. J. Shouse.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 951-965, May 1991. 14 fig, 1 tab, 31 ref.

Descriptors: *Aeration zone, *Field studies, *Path of pollutants, *Porous media, *Soil water, *Solute transport, *Unsaturated flow, Loam, Mass balance, Monitoring, Plumes, Sandy soils, Soil density, Soil physical properties.

A field experiment was undertaken which monitored the three-dimensional movement of cubic solute plumes through an unsaturated, loamy sand soil. The plumes were created with one of two methods, a two-dimensional flux application and an initial resident distribution. Soil coring was used to sample resident concentrations for the three solutes studied. The data were analyzed using the method of moments. In addition to the solute transport experiments, a detailed set of physical properties of the field was obtained by excavating three pits to a depth of 5.0 m and also by taking soil cores throughout the study area. Mass balance varied between 78 and 138 percent. The field-averaged gravimetric water content and dry bulk density were used to accurately predict the mean vertical plume displacements. The plumes spread relatively little in the horizontal direction. Results suggest that the site can be characterized as relatively homogeneous across the field within a given layer or depth, with a high degree of vertical variability between these layers. A slight slope in the layers in a southerly direction was also noted. These observations were supported by examining the experimental mean plume transport within the field. The accurate prediction of the chloride plume center of mass in the flux experiment is an important result that encourages the hope that solute transport may be predicted from independently measured soil properties or parameters. (See also W91-11747) (Doria-PTT)
W91-11746

THREE-DIMENSIONAL FIELD STUDY OF SOLUTE TRANSPORT THROUGH UNSATURATED, LAYERED, POROUS MEDIA. II. CHARACTERIZATION OF VERTICAL DISPERSION.
Agricultural Research Service, Riverside, CA. Salinity Lab.
T. R. Ellsworth, and W. A. Jury.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 967-981, May 1991. 8 fig, 2 tab, 37 ref, append.

Descriptors: *Aeration zone, *Dispersion, *Path of pollutants, *Porous media, *Soil water, *Solute transport, *Unsaturated flow, Advection, Field

studies, Loam, Plumes, Prediction, Sandy soils, Soil texture.

Solute plumes were created in an unsaturated field soil with either flux application or by leaching an initial resident distribution. The spatial variance of the plumes initially increased with time between the soil surface and a depth of 2.5 m, within which the soil was a nearly structureless loamy sand. Below this depth, the plumes were observed to compress in the vertical direction as they moved into, and through, a region of subangular blocky structure and loam texture (between 2.5 and 4.0 m depth). As the solute moved below the layer of fine texture, the plume variance again increased with time. Using a transformed advection-dispersion equation description, two constant, field-averaged transport coefficients were determined in a scaled coordinate system from the moment equations. These two constant parameters were then used to predict the observed local, or plot scale, transport. Results indicate that the two constant parameters describe transport reasonably well at each plot site and over all sampling depths. (See also W91-11746) (Author's abstract)
W91-11747

REGENERATION PROPERTIES OF SPENT TAILORED SOILS.
New Mexico State Univ., Las Cruces. Dept. of Civil, Agricultural and Geological Engineering.
For primary bibliographic entry see Field 5G.
W91-11875

EFFECTS OF SITE DISTURBANCE ON THE MOBILIZATION AND DISTRIBUTION OF NUTRIENTS AND TRACE METALS IN FOREST SOILS.
Maine Univ. at Orono. Dept. of Plant, Soil and Environmental Sciences.
I. J. Fernandez, J. Logan, and C. J. Spencer.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-168997. Price codes: A04 in paper copy, A01 in microfiches. Maine Environmental Studies Center, Orono, Completion Report, August 1989. 63p, 4 fig, 23 tab, 52 ref, 3 append. USGS Contract No. 14-08-0001-G1426. USGS State Project MA-89-30.

Descriptors: *Chemical precipitation, *Forest soils, *Groundwater pollution, *Leaching, *Nutrient transport, *Soil dynamics, *Trace metals, Maine, Soil properties.

A field study was conducted to evaluate the effects of site disturbance on forest soils, with special attention to the mobilization of nutrients and trace metals from the forest floor. The study surveyed a number of disturbance types, including biomass harvesting, site preparation (i.e. chopping, raking, window-burning) and wildlife. In all cases, site disturbance had the effect of reducing organic matter contents in the forest floor and mineral soil, as well as reducing the total N concentrations in the O horizon. Where significant effects of disturbance were found they were best exhibited in the O horizon (forest floor) or in the upper 2 cm of the B horizon. On well-drained soils the altered chemical environment appeared to result in the immobilization of labile Al, Fe, and Mn, whereas evidence suggested Pb and Zn were subjected to some leaching loss judging from NH4NO3 extractable pools. Although no evidence existed to conclude significant groundwater quality risks occurred due to the disturbances studied, evidence does suggest significant release and redistribution of nutrients and metals in the soil following disturbance. The large variability in soil properties will require high sample replication to evaluate disturbance effects more fully in future studies. (USGS)
W91-11880

MEASUREMENT OF SOIL STRUCTURE, WATER MOVEMENT AND SOLUTE TRANSPORT USING COMPUTED TOMOGRAPHY.
Missouri Univ., Columbia. Dept. of Civil Engineering.
R. L. Peyton, S. H. Anderson, and C. J. Gantzer.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-168971. Price codes: A05 in paper copy, A01 in microfiche. Technical Report, 1991. 76p, 31 fig, 2 tab, 110 ref. USGS Contract No. 14-08-0001-G1643.

Descriptors: *Computed tomography, *Fractal mathematics, *Soil porosity, *Soil structure, *Solute transport, Image analysis, Porous media, Soil columns, Soil density, X-ray computed tomography.

Structured, heterogenous porous media present serious problems in predicting water and contaminant movement. X-ray computed tomography (CT) applied to soil cores was found to be an effective tool for nondestructively characterizing small-scale heterogeneity and for measuring small-scale water and solute movement through soil. At a pixel scale of 0.7 x 0.7 mm, autocorrelation and partial autocorrelation functions suggest that soil bulk density is characterized by a first-order autoregressive system in undisturbed soil cores. At a pixel scale of 0.1 x 0.1 mm, macropore diameters can be estimated down to 0.5 mm with a mean error of 3%; errors decrease to less than 1% for diameters greater than 3.0 mm. Perimeter fractal and area fractal methods were used to characterize the spatial variability of soil bulk density using the large data sets produced by CT. Both methods produced unique fractal dimension relationships for forest, field and uniformly-packed soil cores. CT was used to quantify the effect of an artificially-created macropore in a uniformly-packed soil core on the infiltration wetting front. The distribution of solute breakthrough times within a soil core was computed from CT data collected during a solute breakthrough experiment. This data was used to produce a relative frequency distribution of velocities within the core. (USGS)
W91-11909

POSSIBILITIES OF SOIL CLEAN-UP (MOGLICHKEITEN ZUR BODENSANIERUNG).
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W91-12042

AEROBIC AND ANAEROBIC SOIL METABOLISM OF DICAMBA.
Illinois Inst. of Tech., Chicago. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W91-12049

SORPTION OF NONPOLAR AND POLAR COMPOUNDS TO SOILS: PROCESSES, MEASUREMENTS AND EXPERIENCE WITH THE APPLICABILITY OF THE MODIFIED OECD-GUIDELINE 106.
For primary bibliographic entry see Field 5B.
W91-12146

ONE-DIMENSIONAL APPROXIMATION FOR INFILTRATION IN HETEROGENEOUS SOILS.
Polytechnic Univ., Brooklyn, NY. Dept. of Civil and Environmental Engineering.
A. L. Protopapas, and R. L. Bras.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1019-1027, June 1991. 8 fig, 11 ref. NSF Grant CEE8211469.

Descriptors: *Infiltration, *Mathematical models, *Model studies, *Soil water, Approximation method, Hydraulic conductivity, Hydrology, Numerical analysis, Simulation analysis, Soil saturation, Soil types.

By using analytical solutions to the problem of one-dimensional and two-dimensional linearized unsteady infiltration from a strip source in a soil with saturated hydraulic conductivity varying exponentially in space, explicit criteria for the validity of the one-dimensional approximation are derived, in terms of parameters describing the soil type, the uniformity of the infiltrating source at the surface, and the soil heterogeneity. Numerical solutions for the linearized infiltration problem are developed for any variation of hydraulic conductivity in space. Extensive simulations suggest that for a sizable strip source and moderate variation of hydraulic conductivity, a set of independent neighboring soil columns represents well the multidimensional infiltration problem. For the type of soils used in the simulations, it appears that the critical parameters are related to the variations of the saturated hydraulic conductivity and the variations of its extreme values. (See also W91-12219) (Author's abstract)
W91-12218

ANALYTICAL SOLUTIONS FOR UNSTEADY MULTIDIMENSIONAL INFILTRATION IN HETEROGENEOUS SOILS.
Polytechnic Univ., Brooklyn, NY. Dept. of Civil and Environmental Engineering.
A. L. Protopapas, and R. L. Bras.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1029-1034, June 1991. 1 fig, 15 ref. NSF Grant CEE8211469.

Descriptors: *Flow equations, *Infiltration, *Mathematical studies, *Soil water, Heterogeneous soils, Hydraulic conductivity, Hydrology, Numerical analysis, Simulation analysis, Soil saturation, Soil types, Unsaturated flow.

The problem of unsteady multidimensional infiltration in heterogeneous soils was approached analytically. By assuming that the hydraulic conductivity is an exponential function of the soil matric potential and a linear function of the soil moisture, the governing flow equation is linearized for a special variation of the saturated hydraulic conductivity in space. By using integral transform methods, analytical solutions to the one-dimensional and two-dimensional flow problem are derived and shown to be generalized versions of known results for homogeneous soils. The development aims at obtaining quantitative criteria for the validity of the one-dimensional approximation, which is commonly used in hydrologic applications. (See also W91-12218) (Author's abstract)
W91-12219

HILLSLOPE INFILTRATION: DIVERGENT AND CONVERGENT SLOPES.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1035-1040, June 1991. 3 fig, 10 ref.

Descriptors: *Infiltration, *Mathematical models, *Mathematical studies, *Model studies, *Slopes, *Soil water, *Topography, Convergent slopes, Divergent slopes, Flow equations, Flow velocity, Hydrologic models, Hydrology, Infiltration rate, Numerical analysis, Slope effects, Soil saturation, Surface flow.

Analysis of the effects of convergence and divergence on hillslope infiltration indicated that for divergent slopes the depth of moisture penetration is increased slightly. This is accompanied by a slight reduction in the surface moisture gradient and hence also in the infiltration rate. On the other hand, the slightly increased normal depth of penetration gives a small increase in the cross section for downslope flow and therefore also in the total downslope flow. The signs of these various modifications are reversed for convergent slopes. The perturbation analysis of divergence/convergence effects indicated that, in general, these effects are unimportant for usual hillslope topography. Only where the radius of the contour is less than about 10 times the characteristic infiltration length (or 10 times the sorptive length) need the perturbation be taken into account. This result opens up a considerable extension of applicability of the analysis of infiltration on planar hillslopes to embrace slopes with curved contours, such as ridge noses and hollows. (See also W91-12221) (MacKeen-PTT)
W91-12220

INFILTRATION AND DOWNSLOPE UNSATURATED FLOWS IN CONCAVE AND CONVEX TOPOGRAPHIES.
Commonwealth Scientific and Industrial Research

Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1041-1048, June 1991. 4 fig, 11 ref.

Descriptors: *Infiltration, *Mathematical models, *Mathematical studies, *Model studies, *Slopes, *Soil water, *Topography, Contours, Flow equations, Flow velocity, Hydrologic models, Hydrology, Infiltration rate, Numerical analysis, Soil saturation, Unsaturated flow.

The solution of the nonlinear unsaturated flow equation is given for a problem of infiltration (and associated subsurface flows) into concave and convex topographies made up of homogeneous isotropic soil with uniform initial moisture content. The analysis embraces concave and convex surfaces which are parts of the surfaces of circular cylinders and spheres. Thus, concave and convex slopes (of both ridges and isolated hills), valley bottoms and hollows, and ridgecrests and hillcrests are modelled. The major geometrical influence on the flow processes is the slope angle. Only when the inverse of the surface total curvature is less than about 10 times the characteristic infiltration length (or 10 times the sorptive length) does the perturbation due to surface curvature need to be taken into account. Accordingly, the earlier analysis of infiltration on planar hillslopes has wide applicability to slopes with surface curvature. (See also W91-12220) (Author's abstract)
W91-12221

NUMERICAL EVALUATION OF ITERATIVE AND NONITERATIVE METHODS FOR THE SOLUTION OF THE NONLINEAR RICHARDS EQUATION.
Princeton Univ., NJ. Water Resources Program.
C. Paniconi, A. A. Aldama, and E. F. Wood.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1147-1163, June 1991. 7 fig, 3 tab, 33 ref.
NASA Grant NAG-1392.

Descriptors: *Flow, *Model studies, *Porous media, *Richards equation, *Unsaturated flow, Computers, Flow equations, Hydraulic properties, Linearization, Mathematical studies, Numerical analysis, One-dimensional flow, Soil properties.

Several noniterative procedures for solving the nonlinear Richards equation were compared to the conventional Newton and Picard iteration methods. Noniterative strategies for the numerical solution of transient, nonlinear equations arise from explicit or linear time discretizations, or they can be obtained by linearizing an implicit differencing scheme. Two first order accurate linearization methods, a second order accurate two-level 'implicit factored' scheme, and a second order accurate three-level 'Lees' method are presented. The accuracy and computational efficiency of these four schemes and of the Newton and Picard methods were evaluated for a series of test problems simulating one-dimensional flow processes in unsaturated porous media. The results indicate that first order accurate schemes are inefficient compared to second order accurate methods; that second order accurate noniterative schemes can be quite competitive with the iterative Newton and Picard methods; and that the Newton scheme is no less efficient than the Picard method, and for strongly nonlinear problems can outperform the Picard scheme. The two second order accurate noniterative schemes appear to be attractive alternatives to the iterative methods, although there are concerns regarding the stability behavior of the three-level scheme which need to be resolved. It is concluded that of the four noniterative strategies presented, the implicit factored scheme is the most promising, and improved formulations of the method are suggested. (Author's abstract)
W91-12230

PORE SCALE SPATIAL ANALYSIS OF TWO IMMISCIBLE FLUIDS IN POROUS MEDIA.
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-12231

STEADY DISTRIBUTION OF MOISTURE BENEATH A TWO-DIMENSIONAL SURFACE SOURCE.
Sandia National Labs., Albuquerque, NM. Fluid and Thermal Sciences Dept.
M. J. Martinez, and D. F. McTigue.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1193-1206, June 1991. 13 fig, 2 tab, 32 ref.
Department of Energy Contract DE-AC04-76DP00789.

Descriptors: *Infiltration, *Moisture content, *Numerical analysis, *Porous media, *Soil water, Flow, Infiltration rate, Mathematical studies, Moisture profiles, Two-dimensional surface source, Unsaturated flow.

The steady distribution of moisture beneath a two-dimensional strip source was analyzed by applying the quasi-linear approximation. The source is described by specifying either the moisture content or the infiltration rate. A water table is specified at some depth D below the surface, the depth varying from shallow to semi-infinite. Numerical solutions are determined, via the boundary integral equation method, as a function of the material inverse sorptive length (alpha), the width of the strip source (2L), and the depth to the water table. The moisture introduced at the source is broadly spread below the surface when the product of alpha and $L << 1$, for which adsorption by capillary forces is dominant over gravity-induced flow. Conversely, the distribution becomes finger-like along the vertical when the product of alpha and $L >> 1$, where gravity is dominant over adsorption. For a source described by specifying the moisture content, the presence of a water table at finite depth influences the infiltration through the source when the product of alpha and D is less than about 4; infiltration rates obtained assuming the water table depth is semi-infinite are of sufficient accuracy for greater values of the product of alpha and D. When the source is described by a specified infiltration flux, the maximum allowable value of this flux for which the material beneath the source remains unsaturated is determined as a function of nondimensional sorptive number and depth to the water table. (Author's abstract)
W91-12233

QUASI-STEADY VERTICAL TWO-PHASE FLOWS IN POROUS MEDIA.
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
G. J. Weir, and R. M. Young.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1207-1214, June 1991. 8 fig, 13 ref.

Descriptors: *Geothermal studies, *Multiphase flow, *Porous media, *Saturation, *Steady flow, *Vertical flow, Expansion waves, Shocks, Simulation analysis, Theoretical analysis, Viscosity.

Two-phase flow is of interest in geothermal reservoir engineering because extensive regions of steam and liquid water can coexist within geothermal fields. Two-phase flows in which the pressure profile is essentially constant are called quasi-steady. One-dimensional quasi-steady flows have the remarkable property that volumetric flux is essentially independent of position and is a function of time alone. Such volumetric fluxes are (to within an additive constant) inversely proportional to the spatial mean of flowing viscosity. Consequently, the evolution of such a system is controlled by global properties of viscosity. Vertical two-phase quasi-steady flows evolving from an initial steady flow to another steady final flow are analyzed, and the corresponding theory is matched to output from a numerical simulator. Good agreement between the theory and simulator is demonstrated for simple shocks and expansion waves. (Author's abstract)
W91-12234

NUMERICAL APPROXIMATION OF DARCIAN FLOW THROUGH UNSATURATED SOIL.
Arizona Univ., Tucson. Dept. of Soil and Water Science.
A. W. Warrick.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1215-1222, June 1991. 3 fig, 6 tab, 22 ref.

Descriptors: *Darcys law, *Flow, *Flow models, *Hydraulic conductivity, *Model studies, *Soil water, *Unsaturated flow, Approximation method, Flow equations, Infiltration, Mathematical studies, Numerical analysis, Richards equation, Steady flow.

The choice of appropriate intrablock approximations for the unsaturated hydraulic conductivity is a critical step for the numerical solution of the Richards equation. Forms commonly used include arithmetic, geometric and harmonic averaging. The choice is most often based on convenience and custom. A framework for comparing any scheme for weighting the unsaturated hydraulic conductivity against the correct Darcian flow across a block for steady conditions is presented. Such comparisons are carried out for a number of commonly used averages, and errors are shown to be alarmingly high in some cases. A scheme for approximately matching the correct Darcian flux is illustrated by two infiltration examples. In the first, the arithmetic and weighted schemes are superior to the geometric average when compared to a quasi-analytical solution. For the second example, the weighted solution is slightly better than either the arithmetic or geometric averaging schemes. These examples also illustrate that an acceptable mass balance should not be used as a sole criterion for success as it can probably be attained with most schemes. The conclusions are believed relevant for algorithms which are pressure head based, water content based or other choices for multidimensional as well as one-dimensional flow problems. (Author's abstract)
W91-12235

CENTRIFUGAL TECHNIQUES FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W91-12240

SIMULATION OF THE TRANSIENT SOIL WATER CONTENT PROFILE FOR A HOMOGENEOUS BARE SOIL.
Texas Univ. at Austin. Environmental and Water Resources Engineering Group.
For primary bibliographic entry see Field 5B.
W91-12241

FIELD SCALE MASS ARRIVAL OF SORPTIVE SOLUTE INTO THE GROUNDWATER.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
For primary bibliographic entry see Field 5B.
W91-12245

ANALYSES OF INFILTRATION EVENTS IN RELATION TO DETERMINING SOIL HYDRAULIC PROPERTIES BY INVERSE PROBLEM METHODOLOGY.
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
D. Russo, E. Bresler, U. Shani, and J. C. Parker.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1361-1373, June 1991. 6 fig, 3 tab, 34 ref, append.
U.S.-Israel Binational Science Foundation Grant 87-00017.

Descriptors: *Hydraulic conductivity, *Hydraulic properties, *Infiltration, *Model studies, *Soil properties, *Soil saturation, Aeration zone, Data interpretation, Inverse problem method, Mathematical studies, Parameter estimation.

The feasibility of using field measurements of infiltration data as input for the estimation of soil hydraulic properties by inverse problem methodology was evaluated. Circumstances under which the inverse problem is well posed to allow solution were assessed using the concepts of identifiability,

uniqueness, and stability. For this purpose, three different models of soil hydraulic properties were analyzed. The main conclusion is that when infiltration data measured at the Darcy scale are used as input for the inversion procedure, the inclusion of prior information on a single measurable parameter, the saturated conductivity Ks, in the estimation criteria will enhance the likelihood of uniqueness and stability of the inverse solution provided that the structure of the hydraulic model is sufficiently simple. Identifiability was found to depend on the structure of the hydraulic model used to describe the relations between hydraulic conductivity, capillary pressure and water saturation. Uniqueness and stability of the inverse solution depend on the model structure and identifiability of model parameters, and on the magnitude of the measurement error of input data. For a particular situation, it was not possible to determine a priori whether the inverse problem was well posed or not. It is concluded that the method can be useful in characterizing the spatial distributions of hydraulic properties of field soils. (MacKeen-PTT)
W91-12249

RECLAMATION OF A FAILED SUBSURFACE DRAINAGE SYSTEM ON AN UNSTABLE CLAY SOIL.
Victorian Crops Research Inst., Horsham (Australia).
W. K. Gardner, M. C. Fulton, and R. G. Flood.
Australian Journal of Experimental Agriculture AAAHAN, Vol. 31, No. 1, p 93-97, 1991. 1 fig, 3 tab, 11 ref.

Descriptors: *Clay soils, *Drainage engineering, *Gypsum, *Soil structure, *Subsurface drains, Crop yield, Cropland, Diffusion, Drainage patterns, Soil porosity, Subsurface drainage, Sunflowers, Wheat.

The soil structure of a dispersive clay soil on which a subsurface drainage system had failed was modified by applying gypsum (5 ton/hectare) and growing a crop of sunflowers. Failure of the drainage system did not occur under any treatment in 1987, however, there were effects on the structure of the soil. The sunflower crop and gypsum application increased macroporosity from 8 to 15% and stabilized the clay microstructure. Sunflowers without gypsum produced a similar increase in soil macroporosity but with a potentially more dispersive clay microstructure. Gypsum alone produced a stable clay microstructure and intermediate values (about 11%) of macroporosity. The yield of wheat was similar on both drained and undrained areas (4 ton/hectare) following the sunflower crop with and without gypsum application, whereas on untreated areas, yields were 2.1 ton/hectare in the absence of drainage and 3.3 ton/hectare when drained. There was little or no response to subsurface drainage by wheat on areas previously sown to sunflowers. This suggests that gaseous diffusion through the soil was adequate whether the water table was held at 50 cm or fluctuated to the surface. On the fallow, no gypsum area, yields of wheat were less, particularly in the absence of drainage. Air-filled porosity was also lower in this treatment and would have been less in the absence of drainage. (Mertz-PTT)
W91-12254

ROLES OF CLAYS IN SOILS.
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
J. B. Dixon.
Applied Clay Science ACLSER, Vol. 5, No. 5/6, p 489-503, May 1991. 7 fig, 33 ref.

Descriptors: *Clay minerals, *Clays, *Soil chemistry, *Soil properties, *Soil science, *Soil types, Cations, Clay soils, Dispersion, Flocculation, Mineralogy, Particle size, Soil physical properties, Soil structure.

In soil science, the term clay refers to all particles less than 2 microm in diameter and includes layer silicates, oxides and other minerals. The cation exchange properties of clays are among their most important properties in retaining plant nutrient ions (e.g., ammonium ion, K+, Ca++, Mg++, etc.). Cation selectivity of clays influences soils as a plant growth medium and as a disposal medium for radioactive wastes and toxic metal ions. Native K in layer silicates of soils is the most important element provided to plants by illites and other micas. Clays contribute to the formation of soil structure by undergoing seasonal shrinking and swelling. Also, they are transported and form clay films that coat natural aggregates which characterize many friable soils. The dispersion and flocculation of clays are important reactions in the physical behavior of soils which in turn influence friability, water infiltration rate, erodibility and other behavioral properties. Vermiculite and smectite in soils frequently have Al(3+) or polymeric Al on the cation exchange sites. Thus, the behavior of these minerals is different from structurally similar minerals in natural deposits. The Fe oxides in soils occur largely as geothite and hematite, yet they contain Al substituted in their structures; consequently, the crystals are smaller and less soluble than their ideal counterparts. Iron oxides contribute to the color, aggregation, and adsorptive properties of soils. Manganese oxides in soils contribute to the retention of trace metals and to the oxidation of Fe. Lithiophorite forms in acid soils, thus marking another group of minerals that occurs in soils and that is influenced by Al in the structure or in interlayer positions as a result of weathering. (Author's abstract)
W91-12273

PRELIMINARY INVESTIGATION INTO THE MASS TRANSFER PROPERTIES OF A PESTICIDE ONTO ABIOTIC MEDIA.
Oklahoma State Univ., Stillwater.
For primary bibliographic entry see Field 5B.
W91-12286

EFFECTS OF WATER CONTENT AND TEMPERATURE ON EQUILIBRIUM DISTRIBUTION OF ORGANIC POLLUTANTS IN UNSATURATED SOIL.
Korea Advanced Inst. of Science and Technology, Seoul (Republic of Korea). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-12296

INVESTIGATION OF THE RELATIONSHIP BETWEEN PONDED AND CONSTANT FLUX RAINFALL INFILTRATION.
Agricultural Coll. of Athens (Greece).
A. Poulovassilis, P. Kerkides, S. Elmaloglou, and I. Argyrokastritis.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1403-1409, July 1991. 7 fig, 2 tab, 47 ref, append.

Descriptors: *Fluctuations, *Infiltration, *Ponding, *Rainfall infiltration, *Soil water, *Surface-groundwater relationships, Groundwater movement, Hydraulic conductivity, Mathematical equations, Mathematical studies, Rainfall, Theoretical analysis.

The physics of rainfall infiltration under a constant rainfall flux greater than the hydraulic conductivity at saturation was investigated and compared with those pertaining to the infiltration process under flooding. From the theoretically developed arguments, the following conclusions were reached: the moisture profile prevailing at the time the soil surface becomes saturated during the rainfall process ((t=T), where t is time, and T is the time of ponding) is identical to the profile which developed during flooding at an earlier time when the infiltration rate was equal to the rainfall flux (t=tc < T). The rainfall profile development after T was the same as that of the profile under flooding after Tc, the two profiles having a constant time lag equal to (T-tc). The Green and Ampt analysis which was applied to the constant flux rainfall infiltration presupposes the identity of these profiles. In addition to the theoretical arguments, the flow equation was solved numerically for four different soils under conditions that define the two infiltration processes. The numerically obtained results conform with the theoretical analysis. (Author's abstract)
W91-12317

STOCHASTIC MODEL OF INFILTRATION WHICH SIMULATES 'MACROPORE' SOIL WATER FLOW.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
S. A. Grant, J. D. Jabro, D. D. Fritton, and D. E. Baker.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1439-1446, July 1991. 10 fig, 21 ref. USGS Water Resources Research Program Grant 14-08-0001-G1654.

Descriptors: *Infiltration, *Macropores, *Model studies, *Soil water, *Stochastic models, Data interpretation, Groundwater movement, Hydraulic conductivity, Infiltration capacity, Infiltration rate, Porosity, Runoff, Stochastic process.

Estimates of 'macropore' soil water phenomena were calculated from a simple stochastic model of infiltration. Probability density functions (pdf) for cumulative infiltration (I), infiltration rate (I'), and infiltrating-water flux (v) were proposed. Cumulative infiltration is defined as the maximum quantity of water the soil can accept from unponded water supplied at a given location on the soil surface. Similarly, infiltration rate is defined as the maximum rate at which unponded water can enter the soil. The pdfs for cumulative infiltration (f sub I) and infiltration (F sub I') were derived by assuming that the saturated hydraulic conductivity (s) is a lognormal-distributed random variable. The actual infiltrating-water flux depends on I', rainfall rate (Ro), slope, and surface roughness. For a flat and smooth soil surface the pdf for infiltrating-water flux Fv is derived from f sub I' by assuming that water failing to infiltrate into portions of the soil with lower infiltration rates will flow over the soil surface, eventually being accepted by areas with higher infiltration rates. The pdf fv predicts that macropore soil water flow phenomenon will become more pronounced as the rainfall rate approaches the mean infiltration rate, when macropore flux predicted by fv is many times the rainfall rate. These results indicate that a stochastic description of soil hydraulic properties shows promise in describing macropore soil water phenomena. Models of the field-scale effects of macropore soil water flow should include infiltration rate variability and runoff contributions to infiltrating-water flux. (Author's abstract)
W91-12321

STOCHASTIC MODELING OF LARGE-SCALE FLOW IN HETEROGENEOUS UNSATURATED SOILS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
D. J. Polmann, D. McLaughlin, S. Luis, L. W. Gelhar, and R. Ababou.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1447-1458, July 1991. 11 fig, 2 tab, 26 ref, append. Nuclear Regulatory Commission Contract NRC-04-88-074 and NSF Grant CES-8814615.

Descriptors: *Heterogeneity, *Model studies, *Soil water, *Stochastic models, *Unsaturated flow, Anisotropy, Hydraulic conductivity, Mathematical models, Mathematical studies, Soil properties.

A simulation experiment was used to test a stochastic theory of unsaturated flow. Tension means and variances derived from this theory were compared to tension distributions obtained from a previously developed, detailed three-dimensional model. The synthetically generated, unsaturated hydraulic conductivity functions used in the detailed model vary significantly over relatively small distances. Results from a simulated infiltration event indicate that the stochastic theory's predictions reproduce the overall trend of the heterogeneous tension distribution. Deviations from the predicted mean generally lie within confidence intervals derived from the predicted variance. The stochastic theory predicts less vertical moisture movements and somewhat more horizontal spreading than a comparable deterministic analysis. This reflects the fact that the effective hydraulic conductivity function used

in the stochastic approach is anisotropic. The magnitude of this anisotropy increases with increasing tension. (Author's abstract)
W91-12322

HORIZONTAL REDISTRIBUTION WITH CAPILLARY HYSTERESIS.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Centre for Environmental Mechanics.
J. R. Philip.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1459-1469, July 1991. 7 fig, 2 tab, 52 ref.

Descriptors: *Hysteresis, *Soil water, Absorption, Diffusivity, Mathematical analysis, Mathematical studies, Soil columns, Soil properties.

Exact and relatively simple analysis is possible for one hysteretic redistribution process, that in long horizontal columns with the two parts, x < 0 and x > 0, at different uniform moisture contents theta1 and theta2 (theta1 > theta2) at time t=0. The key to its simplicity is its similarity character, with moisture profile x(theta) proportional to t to the 1/2 power. At the interface X=0 there is, for t > 0, a permanent and constant moisture content jump theta 3 to theta4 (theta3 > theta4). The operative moisture potential is the primary drying potential for X < 0, theta1 >/= theta >/= 0, theta4 >/= theta >/= theta2. The operative moisture diffusivity is the primary drying diffusivity for X < 0 and the primary wetting diffusivity for X > 0. The drying diffusivity is greater than the wetting diffusivity near theta-theta1 and less near theta=theta2. Solutions are found for illustrative examples corresponding to four values of H, the relative magnitude of the hysteresis loop. The resorptivity R, the total wet-to-dry exchange of water across x=0 in reduced form, is analogous to the sorptivity S in absorption and infiltration. For the calculated examples, R is about one third of S for the corresponding absorption process and varies only mildly with H. Nonhysteretic calculations may thus give reasonable estimates of R for horizontal hysteretic redistribution, though they cannot give details such as the moisture jump at X=0. Desorption moisture profiles for X < 0 are very gradual, with a large depth of penetration. Absorption profiles for X > 0 are relatively steep, and the penetration depth small. It follows that in experiments the initially wet section of the column should be made some 5-10 times longer than the initially dry sector. (Author's abstract)
W91-12323

HYSTERESIS AND STATE-DEPENDENT ANISOTROPY IN MODELING UNSATURATED HILLSLOPE HYDROLOGIC PROCESSES.
Washington State Univ., Pullman. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-12326

EXACT SOLUTION FOR NONLINEAR, NONHYSTERETIC REDISTRIBUTION IN VERTICAL SOIL OF FINITE DEPTH.
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
G. C. Sander, I. F. Cunning, and W. L. Hogarth.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1529-1536, July 1991. 4 fig, 17 ref, append.

Descriptors: *Infiltration, *Mathematical studies, *Soil water, *Vertical distribution, *Vertical flow, Capillarity, Distribution, Gravity, Soil physics.

A problem of practical importance in soil physics is the redistribution of soil water following either rainfall or irrigation. It is redistribution which determines the quantity of water stored near the soil surface and the length of time this water remains available for plant uptake. An exact analytical solution to the nonlinear, non-hysteretic redistribution of water in a vertical column of soil of finite depth, was analyzed with respect to the effects of gravity, capillarity and initial volume of infiltrated water on the redistribution process. Redistributed profile shapes were found to be consistent with the numerically produced profiles in the absence of hysteresis. A steady-state redistributed profile was derived for arbitrary soil properties. (Lantz-PTT)
W91-12328

ANALYSIS OF SOIL WATER DYNAMICS IN TIME AND SPACE BY USE OF PATTERN RECOGNITION.
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
T. Zhang, and R. Berndtsson.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1623-1636, July 1991. 12 fig, 26 ref.

Descriptors: *Infiltration, *Mathematical analysis, *Soil water, *Statistical analysis, *Unsaturated flow, Dispersion coefficient, Groundwater movement, Heterogeneity, Horizontal flow, Hydraulic conductivity, Hydraulic properties, Soil properties, Spatial variation, Temporal variation, Vertical flow.

A method was developed to use pattern recognition in the analysis of soil water dynamics in time and space simultaneously. Space-time correlation structures are generated by use of a numerical model for the one-dimensional unsaturated flow equation. By applying the method to various soil parameter combinations (unsaturated hydraulic conductivity and dispersion coefficient) and length of infiltration periods it is shown how space-time dependence of soil water changes. The method clearly visualizes effects of change sin infiltrated input and soil heterogeneities which are not noticeable in the original soil water time series. Application of the method to field data reveals small-scale heterogeneities and vertical and horizontal variability in hydraulic properties. The method possesses special advantages when analyzing time-dependent and space-dependent properties simultaneously. Since the method gives a statistical measure of the dependent property that varies within the space-time field, it can be used to interpolate the fields to points where observations are not available, to estimate spatial or temporal averages from discrete observations, and to define regions (spatial or temporal) where observations are the most efficient. (Author's abstract)
W91-12337

SMALL-PERTURBATION SOLUTION FOR STEADY NONUNIFORM INFILTRATION INTO SOIL SURFACE OF A GENERAL SHAPE.
Hebrew Univ. of Jerusalem (Israel). Seagram Centre for Soil and Water Sciences.
R. Wallach, M. Israeli, and D. Zaslavsky.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1665-1670, July 1991. 5 fig, 10 ref.

Descriptors: *Infiltration, *Mathematical studies, *Nonuniform flow, *Soil properties, *Soil water, *Soil-water relationships, Distribution patterns, Fluctuations, Infiltration rate, Linear equations, Mathematical equations, Ponding, Topography.

A steady state solution is developed for three-dimensional infiltration where both the water flux at the soil surface and the soil surface topography are nonuniform. By identifying a small parameter, which is defined as a ratio between the vertical and the horizontal characteristic lengths, the solution of the linearized equation can then be found by using perturbation methods. The spatial variation of both the soil surface topography and the water flux entering the profile appears only in parametric form in the equations and boundary conditions to all orders of approximation, thus allowing easy evaluation of the solution. The water accumulation due to soil surface topography is related to the inner produce between the gradients of the surface elevation and the rate of infiltration at the soil surface. Therefore, the non-uniformity of the soil surface should be accompanied by a spatial non-uniformity of the applied flux in order to produce lateral variations in the solution. This method can be used to evaluate the water accumulation in the soil due to general rainfall or irrigation distributions. It can also be used for design purposes in cases where one or both sources of non-uniformities in the horizontal directions can be controlled, as for example, in an irrigation system in a field with a given topography. (Author's abstract)
W91-12341

RECENT STUDIES OF FLOW AND TRANSPORT IN THE VADOSE ZONE.
Battelle Pacific Northwest Labs., Richland, WA.
G. W. Gee, C. T. Kincaid, R. J. Lenhard, and C. S. Simmons.
Reviews of Geophysics RVGPB4, Vol. Supp, p 227-239, 1991. 202 ref. DOE Contract DE-AC06-76RLO 1830.

Descriptors: *Groundwater movement, *Literature review, *Model studies, *Path of pollutants, *Soil water, *Solute transport, *Vadose zone, Heterogeneity, Hydraulic properties, Stochastic analysis.

Vadose zone hydrology has received increased attention in recent years as a result of environmental concerns over potential groundwater pollution from buried wastes. Funding agencies have supported several comprehensive field studies designed to improve and test models that describe flow and transport of contaminants in heterogeneous field soils. Extensive databases, containing measured hydraulic properties and observations of flow and transport, have been established and have been useful for model testing and comparison. Improvements in stochastic and deterministic modeling capabilities for the vadose zone have been made. The stochastic models provide a way to account for site variability. The improved deterministic models conserve mass and are computationally efficient. This literature review discusses recent progress in the areas of model validation, stochastic and deterministic analysis, multiphase flow and transport, preferred pathway analysis, and other related topics. (Author's abstract)
W91-12508

TILLAGE AND CROP RESIDUE MANAGEMENT AFFECT VERTISOL PROPERTIES AND GRAIN SORGHUM GROWTH OVER SEVEN YEARS IN THE SEMI-ARID SUB-TROPICS. 1. CROP RESIDUE AND SOIL WATER DURING FALLOW PERIODS.
Queensland Dept. of Primary Industries, Toowoomba (Australia). Wheat Research Inst.
For primary bibliographic entry see Field 3F.
W91-12525

DEVELOPMENT OF WATER POTENTIAL GRADIENTS IN NON-ROOTED AGGREGATES IN RELATION TO AGGREGATE SIZE AND RELATIVE HUMIDITY OF THE AIR.
Hanover Univ. (Germany, F.R.). Inst. fuer Bodenkunde.
For primary bibliographic entry see Field 2I.
W91-12526

EFFECT OF TILLAGE AND RESIDUE MANAGEMENT ON HYDRO-THERMAL REGIME, NUTRIENT UPTAKE AND YIELD OF WHEAT IN A RIVER DEPOSIT.
Himachal Pradesh Krishi Vishva Vidyalaya, Palampur (India). Dept. of Soil Sciences and Water Management.
For primary bibliographic entry see Field 3F.
W91-12529

SOILS OF THE FLOOD PLAIN OF OYUN RIVER IN THE SOUTHERN GUINEA SAVANNA OF NIGERIA AND THEIR CROP PRODUCTION POTENTIAL.
Ilorin Univ. (Nigeria). Dept. of Crop Production.
J. A. Ogunwale.
Agrochimica AGRCAX, Vol. 34, No. 5/6, p 365-375, December 1990. 2 fig, 4 tab, 15 ref. University of Ilorin Senate Research Grant 8-361-01.

Descriptors: *Crop production, *Flood plains, *Nigeria, *Soil moisture retention, *Soil types, *Wetlands, Clays, Drainage, Irrigable land, Mineralogy, Morphology, Soil chemistry, Soil properties.

The soils of the lower slope of Bolorunduro cateria, which constitutes the flood plain of the Oyun River in the Southern Guinea Savanna of Nigeria, were studied. Tests were conducted to determine the morphological, chemical and mineralogical properties of the soils, as a guide to better management in their agricultural use. Soil samples were collected from pedogenic horizons from each of four profiles. Pedons 1 and 2 are well-drained, pedon 3 is moderately well-drained while pedon 4 is imperfectly drained. The imperfectly drained pedon 4 is richer in exchangeable bases, organic matter, total nitrogen and available phosphorus contents than the other three better drained pedons. The clay mineralogy of the four pedons indicate the predominance of metalhalloysite over degraded-mica and interstratified expansible-type minerals. The dominance of metalhalloysite in the soils implies that moisture retention is better in the soil of these flood plains than it is in the soils if the lower Ofiki basin, also in Nigeria. The presence of interstratified expansible-type minerals is more pronounced in the imperfectly-drained pedon 4 than in the other three better drained pedons and indicates that this pedon holds promise for dry season irrigated farming. Moderate to high yields of Sugar cane (30.3-50.7 ton/ha), tomato (2.2-6.1 ton/ha) and maize (2.1-2.2 ton/ha) indicate that the soils of the area studied have great potential for crop production in the ecological zone. (Agostine-PTT)
W91-12533

REGIONAL WATER FLOW AND PESTICIDE LEACHING USING SIMULATIONS WITH SPATIALLY DISTRIBUTED DATA.
Cornell Univ., Ithaca, NY. Dept. of Soil, Crop and Atmospheric Sciences.
For primary bibliographic entry see Field 5B.
W91-12547

SYSTEM MODELING APPROACH FOR SOLUTE TRANSPORT THROUGH UPPER SOILS.
Hawaii Univ., Honolulu. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-12577

REMOTE DETERMINATION OF SOIL MOISTURE AND EVAPOTRANSPIRATION FROM THERMAL INFRARED MEASUREMENTS: DETECTION OF A DRYING THRESHOLD.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
For primary bibliographic entry see Field 2D.
W91-12628

STEADY-STATE UNSATURATED-ZONE MODEL TO SIMULATE PESTICIDE TRANSPORT.
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-12662

ELUTION PROFILES OF THREE CHLORINATED HYDROCARBONS LEACHING THROUGH SANDY SOIL.
Illinois Univ. at Chicago Circle. School of Public Health.
For primary bibliographic entry see Field 5B.
W91-12817

POLYMER EFFECTS ON THE HYDRAULIC CONDUCTIVITY OF SALINE AND SODIC SOIL CONDITIONS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3F.
W91-12900

2H. Lakes

DETRITUS AND THE CONCEPT OF NON-PREDATORY LOSS.
Vienna Univ. (Austria). Inst. fuer Allgemeine Biologie.
B. Velimirov.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 1, p 1-20, March 1991. 2 tab, 79 ref. Fonds zur Forderung der wissenschaftlichen Forschung Projekt Nr. P 6559 B.

Descriptors: *Decomposing organic matter, *Detritus, *Non-predatory loss, Literature review.

A literature study on decomposition processes and detritus dynamics showed that there are numerous definitions of detritus in the aquatic literature of the last 20 years, and there are strong differences among those definitions. Most investigators define a particular type of particulate organic matter to standardize their experiments or restrict themselves to the description of the most dominant particle type within their working area. A functional definition of general value equates detritus with non-predatory carbon loss from any trophic level and integrates ecosystem relevant aspects of energy flow into the definitions. The investigation of the qualitative aspects of classical examples for non-predatory losses, namely egesta and material resulting from ecological mortality, showed that egesta contain mostly material which is lost from the trophic level being preyed upon, and is therefore a loss induced by the activity of a predator. Thus the term non-predatory loss is not an adequate formulation to describe fecal material, which is generally considered as detritus. Non-predatory losses include living organic matter, and a distinction between live and dead non-predatory loss is necessary. Preliminary data from energy flow studies indicate that the living non-predatory losses of particulate plant material may range from 5-50% of the biomass of dead, non-predatory plant loss and may remain alive for long periods of time. To include this particulate component, a modified definition of detritus is proposed: detritus is a non-predatory and predatory induced loss of organic matter from any trophic level (includes egestion, excretion, secretion, etc.) or input from sources external to the ecosystem that enters and cycles in the system (allochthonous organic carbon), regardless of the size of the material; it is all dead organic matter, distinguishable from living organic and inorganic matter. (Author's abstract)
W91-11615

WHICH FACTORS CONTROLLED SEASONAL AND SPATIAL DISTRIBUTION OF PHYTOPLANKTON SPECIES IN SCHLACHTENSEE (BERLIN, F.R.G.) 1987.
Freie Univ. Berlin (Germany, F.R.). Inst. fuer Systematische Botanik und Pflanzengeographie.
F. Gervais.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 1, p 43-65, March 1991. 10 fig, 2 tab, 47 ref.

Descriptors: *Algae, *Germany, *Lake ecology, *Limnology, *Phytoplankton, *Population dynamics, *Schlachtensee, Hydrogen ion concentration, Phosphates, Photosynthesis, Seasonal variation, Sedimentation, Silicon, Solar radiation, Spatial distribution, Vertical distribution.

The periodicity in phytoplankton dynamics in Schlachtensee in 1987 was investigated. Causal connections between the seasonality of algal populations and of important environmental factors in Schlachtensee are shown, and seasonality is compared with the observations, experiments and hypotheses of other investigations. The spring maximum of algal biomass was dominated by cryptophytes and large diatoms, the former profiting by their winter inoculum, the latter by their high photosynthetic efficiency and capacity. Crustacean grazing, as well as Si limitation of biomass and sedimentation, probably led to the decline of the spring populations. These were followed by two populations of large colonial chrysophytes that profited by mobility, independence of higher Si concentrations, efficient phosphate uptake and the ability to grow mixotrophically. Grazing and a temporary increase in pH might have caused the decline of these chrysophyte populations. In summer, large populations of inedible Ceratium spp. that, by diel vertical migration, might have derived benefit from the exploitation of nutrients concentrated in the hypolimnion, dominated the phytoplankton assemblage. Increasing mixing depth prevented vertical migration and decreased the effective light climate, thus leading to the breakdown of the Ceratium populations. With the replenishment of Si as a result of full overturn in autumn, a large diatom, Fragilaria crotonensis, prevailed in Schlachtensee until the decline in global radiation led to the winter minimum of phytoplankton biomass. In Schlachtensee, considerable vertical inequality of phytoplankton biomass and assemblage composition was observed as a result of slow sedimentation of diatoms, of vertical migration of flagellates and of hypolimnetic growth of Cryptomonas. The comparison of two lake basins showed no fundamental horizontal differences in periodicity of phytoplankton biovolume and species composition in 1987. Significant changes in phytoplankton biomass, species composition and periodicity have occurred with increasing success of restoration in Schlachtensee. (Author's abstract)
W91-11617

SPECIES COMPOSITION AND DYNAMICS OF THE PHYTOPLANKTON IN A RECENTLY-COMMISSIONED RESERVOIR (AZIBO, PORTUGAL).
Porto Univ. (Portugal). Inst. de Zoology.
V. M. Vasconcelos.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 1, p 67-78, March 1991. 8 fig, 24 ref.

Descriptors: *Limnology, *Phytoplankton, *Population dynamics, *Reservoirs, *Species composition, Azibo Reservoir, Chlorophyta, Cyanophyta, Diatoms, Nitrogen, Phosphorus, Portugal, Rainfall, Seasonal variation, Silicon.

The phytoplankton community of the recently constructed Azibo Reservoir in Tras-os-Montes, Portugal was studied during a two-year period in relation to some physical and chemical properties of the water. The pattern of variation of the phytoplankton community was not regular through time. In the first year, the community was quite diverse with Chlorophyceae, Bacillariophyceae and Cryptophyceae as the main groups, with some Chrysophyceae and Dinophyceae. In the second year, the major groups were Bacillariophyceae in winter and spring and Cyanobacteria in summer. This shift in dominance was probably mediated by changes in the P, N and Si loads, and by weather conditions, namely the extremely low amount of rainfall during the 1988 spring and summer. The high consumption of silica by Asterionella formosa during the 1988 winter seems to be the main cause of the decline of diatoms in the following summer. (Author's abstract)
W91-11618

WATER QUALITY AND PLANKTON PERIODICITY IN TWO CONTRASTING MINE LAKES IN JOS, NIGERIA.
Jos Univ. (Nigeria). Dept. of Zoology.
D. I. Anadu, A. Obioha, and C. Ejike.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 17-25, December 1990. 5 fig, 1 tab, 19 ref.

Descriptors: *Limnology, *Mine lakes, *Nigeria, *Periodicity, *Phytoplankton, *Zooplankton, Alkalinity, Chlorophyta, Comparison studies, Copepods, Cyanophyta, Diatoms, Dissolved solids, Hydrogen ion concentration, Mining, Nitrates, Nitrogen, Oligotrophic lakes, Phosphates, Phosphorus, Rotifers, Water quality, Waterfleas.

Water quality and plankton periodicity was investigated in two mine lakes near Jos in the younger granite area of Plateau State, Nigeria, for eight months. Transparency, pH and nitrate-nitrogen were significantly higher in Lake II while dissolved organic matter (DOM), alkalinity, phosphate-phosphorus, BOD and chloride were significantly higher in Lake I. The order of dominance in Lake I was Bacillariophyceae, Cyanophyceae, Chlorophyceae and Dinophyceae; the order for Lake II was Chlorophyceae, Cyanophyceae, Bacillariophyceae and Dinophyceae. In Lake I the zooplankton, in order of dominance, were Cladocera, Rotifera, Copepoda and nauplii, while in Lake II,

they were Cladocera, Copepoda, Rotifera, and nauplii. Although both lakes would seem unproductive based on the phosphate-phosphorus and nitrate-nitrogen levels, Lake I appears more productive than Lake II. (Author's abstract)
W91-11622

REVIEW OF SOME CHARACTERISTICS OF FRESHWATER AND COASTAL ECOSYSTEMS IN GHANA.
Institute of Aquatic Biology, Achimota (Ghana).
For primary bibliographic entry see Field 2L.
W91-11625

BIOLOGICAL OBSERVATIONS ON FRESHWATER SYSTEMS ADJACENT TO THE COAST OF SIERRA LEONE.
Ministry of Agriculture, Natural Resources and Forestry, Freetown (Sierra Leone). Fisheries Div.
N. B. Iscandri.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 63-73, December 1990. 5 fig, 3 tab, 15 ref.

Descriptors: *Coastal environment, *Developing countries, *Fisheries, *Flood plains, *Lakes, *Limnology, *Rivers, *Sherbro Estuary, *Sierra Leone, Climates, Fish populations, Seasonal variation, Species composition.

The Waange-Sewa basin with its extensive floodplains forms the major part of the Sherbro estuary, and is identified as one of the foremost areas for agriculture and fisheries in the southern part of Sierra Leone. Preliminary analysis on basic physicochemistry and fish fauna of the rivers and lakes within the Waange-Sewa basin were made for the dry season and rainy season of 1983. Physicochemical variables were used to estimate fish production for the river, floodplains, and lakes. Sierra Leone has an imbalanced food budget and cannot, in the short-term, increase fish harvests. Improvement of the country's inland fisheries potential as a alternative protein supply is needed. The climatic conditions are particularly suited to tropical fish production with guaranteed near all-year round growth and abundant water reserves. (Brunone-PTT)
W91-11627

ALKALINE, SALINE LAKES OF UGANDA: A REVIEW.
Uganda Freshwater Fisheries Research Organization, Jinja.
S. Mungoma.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 75-80, December 1990. 1 fig, 2 tab, 18 ref.

Descriptors: *Alkalinity, *Closed basins, *Evaporation, *Limnology, *Saline lakes, *Salinity, *Uganda, *Water chemistry, Carbonates, Chemical stratification, Chlorides, Ions, Sulfates, Temporal variation, Thermal stratification, Western Rift Valley.

Most saline lakes in Uganda are alkaline and occur in closed basins associated with the Western Rift Valley. They are small shallow lakes exhibiting considerable temporal variation in volume and surface area. They have been categorized as maar lakes. Salinity in these lakes results from evaporative concentration of ions leached from their drainage basins. These lakes can be grouped into these broad categories: carbonate-chloride, sulfate-chloride, and chloride lakes according to the dominant anion(s). The relative amounts of ions in solution determines, in part, the limnochemical characteristics of the lakes. Some evidence exists of thermal and chemical stratification in the deeper lakes. Records of the limnobiology in these lakes are scarce and not exhaustive. (Author's abstract)
W91-11628

MASSIVE FISH KILLS WITHIN THE NYANZA GULF OF LAKE VICTORIA, KENYA.
Kenya Marine and Fisheries Research Inst., Kisumu. Kisumu Lab.
For primary bibliographic entry see Field 5C.
W91-11629

ECOLOGY AND ROLE OF ZOOPLANKTON IN THE FISHERY OF LAKE NAIVASHA.
Nairobi Univ. (Kenya). Dept. of Zoology.
K. M. Mavuti.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 131-140, December 1990. 3 fig, 3 tab, 33 ref.

Descriptors: *Fish food organisms, *Food chains, *Introduced species, *Kenya, *Lake Naivasha, *Lake fisheries, *Limnology, *Zooplankton, Black bass, Copepods, Cycling nutrients, Fish populations, Nutrient concentrations, Phytoplankton, Population density, Rainfall, Rotifers, Species composition, Species diversity, Tilapia, Trophic level, Water level, Water temperature, Waterfleas.

Exploitation of fisheries resources in Kenya, as well as elsewhere in Africa, has been carried out in the absence of adequate ecological knowledge of fish-food organisms. Thus, studies on the zooplankton community were undertaken to establish their composition, structure and ecological role in the fishery of Lake Naivasha, Kenya. The present fish fauna of the lake is comprised of introduced species; the major part of the Lake's fishery is based on the large-mouth black bass, Micropterus salmoides, and the tilapias, Oreochromis leucostictus and Tilapia zillii. The taxonomic composition, distribution, community structure and seasonality of Lake Naivasha zooplankton are outlined for the period between 1978 and 1988. Primary zooplankton groups are Copepoda, Cladocera, and Rotifera. In the first year of study, zooplankton biomass and density were positively and significantly correlated with rainfall and rising lake level. Neither density nor biomass of the zooplankton correlated significantly with water temperature. In the littoral areas of Lake Naivasha, the zooplankton community plays a major role as a food resource for the fish fry and juveniles, leading to increased fishery production in the lake. Similarly, in the lake's role in nutrient recycling and grazing on the phytoplankton in the lake must be significant, but remains to be quantified. The almost total absence of zooplanktivores in the limnetic area of the lake is a major trophic gap in the pelagic food chain. The limnetic zooplankton community is composed of large species, indicative of a population with few or no predators; consequently production is not significantly utilized by higher trophic levels and most of it enters the decomposer food chain. (Brunone-PTT)
W91-11632

ACID SENSITIVITY AND WATER CHEMISTRY CORRELATES OF AMPHIBIAN BREEDING PONDS IN NORTHERN WISCONSIN, USA.
Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 5C.
W91-11633

RESPONSES OF A EUTROPHIC POND COMMUNITY TO SEPARATE AND COMBINED EFFECTS OF N:P SUPPLY AND PLANKTIVOROUS FISH: A MESOCOSM EXPERIMENT.
Texas Christian Univ., Fort Worth. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-11634

HYDROLOGIC PROCESSES IN A SOUTHERN ONTARIO WETLAND.
Ontario Ministry of the Environment, Toronto.
J. Gehrels, and G. Mulamoottil.
Hydrobiologia HYDRB8, Vol. 208, No. 3, p 221-234, December 10, 1990. 1 fig, 5 tab, 50 ref.

Descriptors: *Cycling nutrients, *Eutrophication, *Groundwater movement, *Hydrologic cycle, *Mass balance, *Ontario, *Path of pollutants, *Phosphorus, *Storm runoff, *Water pollution sources, *Wetlands, Evapotranspiration, Flow discharge, Future planning, Hydrologic models, Nutrient concentrations, Orthophosphates, Phosphates, Water chemistry, Water resources management.

The hydrology of a southern Ontario wetland (Hidden Valley wetland, a 18-hectare cattail marsh located in Kitchner, Ontario) was investigated over one year, with over 800 grab samples analyzed to measure the mass flux of water and concentrations of total phosphates, orthophosphates, and chlorides in all components of the hydrologic budget. The study showed that both groundwater recharge and discharge could occur within a wetland; data on these opposing flows must be quantified to develop effective long-term wetland management strategies and to accurately determine nutrient budgets. Theoretical formulae may greatly underestimate summer evapotranspiration rates for hydrophyte dominated marshes. Storm inputs of physicochemical parameters were very significant, accounting for 32 to 51% of the total surface water loadings; failure to measure and/or model these inputs would have greatly distorted study findings. Finally, since flow rates and concentrations of the chemical parameters were less variable at the wetland outflow, wetland moderates event response inputs into stable response outputs. Over the study period, total phosphate imports were double that of total phosphorus exports while the orthophosphate discharge from the wetland was 22% more than the inputs. These results indicate that the wetland is transforming sediment-bound phosphate to plant available orthophosphate, thus contributing to downstream eutrophication problems. (Author's abstract)
W91-11636

CADMIUM, COPPER AND LEAD IN AQUATIC MACROPHYTES IN SHOAL LAKE (MANITOBA-ONTARIO).
Winnipeg Univ. (Manitoba). Dept. of Biology.
E. Pip.
Hydrobiologia HYDRB8, Vol. 208, No. 3, p 253-260, December 10, 1990. 2 tab, 43 ref.

Descriptors: *Aquatic plants, *Cadmium, *Copper, *Lead, *Macrophytes, *Manitoba, *Ontario, *Plant physiology, *Shoal Lake, *Trace metals, Chlorophyll, Ion concentrations, Starch, Sugars, Water chemistry, Water level, Water temperature.

Cadmium, copper and lead concentrations were surveyed in several species of submerged aquatic macrophytes in a Precambrian Shield Lake. Values were variable within each species and interspecific differences in metal concentration were not significant over the season as a whole. Cadmium concentration increased during the season in Potamogeton foliosus and Myriophyllum exalbescens, while copper and lead declined in P. foliosus. No identifiable seasonal trends were seen in P. zosteriformis and P. robbinsii. In P. foliosus, copper and lead concentrations increased with water depth. Few significant correlations were found between metal concentrations in the shoots and each of several water chemistry parameters, temperature, and shoot chlorophyll, soluble sugar and starch content. Roots yielded greater metal concentrations than shoots. A number of factors, active as well as passive, combine to influence metal concentrations in macrophyte tissues. (Author's abstract)
W91-11637

RECOLONISATION OF FOUR SMALL STREAMS IN CENTRAL SCOTLAND FOLLOWING DROUGHT CONDITIONS IN 1984.
Freshwater Fisheries Lab., Pitlochry (Scotland).
For primary bibliographic entry see Field 2E.
W91-11638

RAIN-POOLS ON PEAT MOORLAND AS ISLAND HABITATS FOR MIDGE LARVAE.
Newcastle upon Tyne Univ. (England). Dept. of Biology.
J. M. Jackson, and A. J. Mclachlan.
Hydrobiologia HYDRB8, Vol. 209, No. 1, p 59-65, February 1991. 3 fig, 5 tab, 15 ref. Natural Environment Research Council Studentship GT4/80/ALS/23.

Descriptors: *Aquatic habitats, *Larvae, *Midges, *Moors, *Peat, *Population density, *Puddles, *Wetlands, Endemism, Insects, Juveniles, Rainfall, Seasonal distribution, Spatial distribution.

A common aquatic habitat on peat moorland is a pool, often only a few centimeters deep. Many have a shorter average duration than that of the inhabitants but they are, nonetheless, inhabited by the larval stages of several chironomid species at moderately high densities. Because of their durational characteristics, these pools might be expected to have an endemic fauna, as in the case in similar ephemeral island habitats elsewhere. However, no qualitative differences are noted between ephemeral and permanent pools of the same substratum. Three reasons for the apparent absence of endemism exist: the midge fauna is able to survive dry periods in the moist mud, so that even the smallest pools are effectively permanent from the adaptive point of view; although seasonal freezing eliminates the fauna of smaller pools, larvae are able to complete their development in the preceding summer; and, nearby permanent pools which do not dry and in which the mud does not freeze, may act as refugia for re-invasion. (Author's abstract)
W91-11640

CENTRIFUGAL FLOTATION AS AN AID TO SEPARATING INVERTEBRATES FROM DETRITUS IN BENTHIC SAMPLES.
Toronto Univ. (Ontario). Div. of Life Sciences.
For primary bibliographic entry see Field 7B.
W91-11641

NUTRIENT DYNAMICS AND PELAGIC FOOD WEB INTERACTIONS IN OLIGOTROPHIC AND EUTROPHIC ENVIRONMENTS: AN OVERVIEW.
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 5G.
W91-11683

CONTRIBUTION OF THE WATER-SEDIMENT INTERFACE TO THE TRANSFORMATION OF BIOGENIC SUBSTANCES: APPLICATION TO NITROGEN COMPOUNDS.
Centre Univ. de Luminy, Marseille (France).
For primary bibliographic entry see Field 2L.
W91-11684

LONG-TERM CHANGES IN ZOOPLANKTON ABUNDANCE AND WATER TRANSPARENCY IN LAKE GENEVA.
Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Inst. de Limonologie.
G. Balvay.
Hydrobiologia HYDRB8, Vol. 207, p 31-36, November 22, 1990. 3 fig, 23 ref.

Descriptors: *Eutrophication, *Lake Geneva, *Limnology, *Switzerland, *Transparency, *Water pollution effects, *Zooplankton, Nutrient concentrations, Phosphorus, Phytoplankton, Population density, Wastewater, Water pollution control.

The water quality of Lake Geneva has declined steadily since the 1960s, due to a continuous increase of external phosphorus loading. Average phosphorus loading in the lake increased steadily to a peak in 1979, and even 1981 in the case of phosphorus content in the trophogenic layer. Since then, reduced external inputs related to the delayed effects of phosphorus removal from wastewaters initiated many years previously has led to a decrease in phosphorus level, and resulted in present stabilization and even improvement in water quality. Long-term changes in zooplankton abundance correspond quite closely to eutrophication level changes. After increasing since the 1960s, maximum zooplankton biomass was recorded for the first time in 1971; a second main peak appeared in 1981 together with the highest eutrophication level. Over the last seven years, zooplankton abundance has decreased continuously, while water transparency has decreased and phytoplankton has remained at a high level. (Author's abstract)
W91-11685

SEASONAL COUPLING BETWEEN PHYTO- AND BACTERIOPLANKTON IN A SAND PIT LAKE (CRETEIL LAKE, FRANCE).
Ecole Normale Superieure, Paris (France). Lab. d'Ecologie.
J. Garnier, and D. Benest.
Hydrobiologia HYDRB8, Vol. 207, p 71-77, November 22, 1990. 3 fig, 44 ref.

Descriptors: *Aquatic bacteria, *Biomass, *France, *Lake ecology, *Limnology, *Phytoplankton, Algal physiology, Amino acids, Comparison studies, Creteil Lake, Cycling nutrients, Dominance, Glucose, Photosynthesis, Population density, Seasonal variation.

Phytoplankton and bacterioplankton biomass and activity were simultaneously measured during the course of one year in the shallow Creteil Lake (France). Phytoplankton was dominated, during the whole year, by small-sized organisms (1 to 25 microm). Bacteria were primarily small coccoids (<0.3 microm). Phytoplankton and bacterioplankton abundances averaged respectively 3,300,000 cells/L and six billion cells/L. The phasing of these activity and biomass periods suggest a close coupling between phytoplankton and bacterioplankton. Maximal values were observed in summer, but an early increase occurred also in winter. Low or undetectable phytoplankton excretion rates, when heterotrophic activity was maximum, indicated a bacterial uptake of up to 100% of the released algal products during the incubation period. Heterotrophic uptake measurements with both glucose and amino acids revealed a seasonal change of the substrates in the lake, glucose uptake being associated more with the maximum activity of the algae, while the amino acids uptake was relatively higher during their decline. The maximal photosynthetic rate averaged 21.5 mg C/cubic m/hour and mean substrate uptake (Vmax) values were 0.056 and 0.050 mg C/cubic m/hour respectively for glucose and amino acids uptake. (Author's abstract)
W91-11689

DYNAMICS OF BACTERIOPLANKTON IN A MESOTROPHIC FRENCH RESERVOIR (PAREL OUP).
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
P. Lavandier.
Hydrobiologia HYDRB8, Vol. 207, p 79-86, November 22, 1990. 3 fig, 29 ref.

Descriptors: *Bacterioplankton, *France, *Lake ecology, *Limnology, *Productivity, *Thymidine, Autotrophy, Bacterial growth, Biomass, Carbon cycle, Euphotic zone, Population density, Seasonal distribution, Water column.

Bacterioplankton abundance, biomass, and production were studied at a central station (35 m depth) from April 1987 to September 1988 in a mesotrophic reservoir. Bacterial production was calculated by the tritiated thymidine method. For the water column, integrated estimates of bacterioplankton abundance ranged from 2.3 billion to 4.6 billion cells/L, and carbon biomass from 0.037 to 0.068 mg C/L; the thymidine incorporation rates ranged from 0.8 to 17.2 picomoles/L/hour, leading to net bacterial production estimates of less than 0.7 microg C/L/day in winter to 18 microg C/L/day in summer. About 55% of the production occurred in the euphotic layers. Over the year, the bacterial carbon requirement represented 90% of the autotrophic production for the whole lake, and was five times lower than autotrophic production in spring, two times as high in summer. This important temporal lack of balance suggests that not all the spring primary production products are consumed immediately and/or that other carbon sources probably support bacterial growth in summer. (Author's abstract)
W91-11690

DAILY CYCLES OF DISSOLVED OXYGEN AND NUTRIENT CONTENT IN A SHALLOW FISHPOND: THE IMPACT OF WATER RENEWAL.
Bordeaux-1 Univ., Talence (France). Inst. de Biologie Marine.
V. Escaravage.
Hydrobiologia HYDRB8, Vol. 207, p 131-136, November 22, 1990. 5 fig, 1 tab, 16 ref.

Descriptors: *Dissolved oxygen, *Fish ponds, *France, *Lagoons, *Limnology, *Nutrient concentrations, *Organic matter, *Oxygen requirements, *Water transfer, Ammonium, Arcachona Bay, Diurnal variation, Hydrogen ion concentration, Microorganisms, Nitrates, Nitrites, Phosphates, Primary productivity, Salinity.

Eutrophic lagoons and ponds act as traps for organic materials of both autochthonous and allochtonous origin. Short-term variation of nutrients in relation to community oxygen metabolism were studied in a shallow fishpond located on the eastern side of Arcachona Bay, France. Dissolved oxygen, pH and nutrient content (ammonium, nitrite, nitrate, and phosphate) showed pronounced diel variations. These phenomena seemed to be directly controlled by biological processes. Microbially mediated degradation of organic matter constitutes the main source of nutrients in the water column and primary producers consume the major part of these products. These processes are closely coupled to the light-dark cycle. Man-induced water renewal caused modifications in nutrient concentration and did not alter temporal dynamics. (Author's abstract)
W91-11696

VARIATION OF NUTRIENT STOCKS IN THE SUPERFICIAL SEDIMENTS OF LAKE GENEVA FROM 1978 TO 1988.
Institute F.-A. Forel, 10 route de Suisse, CH-1290 Versoix, Switzerland.
D. Span, D. Arbouille, H. Howa, and J. P. Vernet.
Hydrobiologia HYDRB8, Vol. 207, p 161-166, November 22, 1990. 5 fig, 1 tab, 10 ref.

Descriptors: *Cycling nutrients, *Lake Geneva, *Limnology, *Nutrient transport, *Path of pollutants, *Phosphorus, *Sediment chemistry, *Sediment-water interfaces, *Switzerland, Aerobic conditions, Anaerobic conditions, Eutrophication, Nitrogen, Organic carbon, Water pollution effects.

Two sediment sampling campaigns were conducted in 1978 and 1988 in Lake Geneva (Switzerland). Organic carbon, total nitrogen, total phosphorus and its various forms were analyzed. Results indicate stabile concentration of organic carbon and nitrogen, and a significant increase in phosphorus. The variation phosphorus concentration is related to the increase of nonapatite inorganic phosphorus. The phosphorus exchanges at the water-sediment interface were quantified. The dissolved oxygen level in the bottom water determines the exchange direction. In aerobic conditions, sediments accumulate the excess phosphorus, while in anaerobic conditions, they constitute an internal source. Despite improvements in wastewater treatment and the phosphorus ban in detergents since 1986 in Switzerland, eutrophication remains a serious problem because of the remobilization potential of a part of the sedimentary phosphorus resulting from previous pollution. (Brunone-PTT)
W91-11700

PHOSPHORUS MOBILITY IN INTERSTITIAL WATERS OF SEDIMENTS IN LAKE KINNERET, ISRAEL.
Bayreuth Univ. (Germany, F.R.). Limnologische Station.
B. Staudinger, S. Peiffer, Y. Avnimelech, and T. Berman.
Hydrobiologia HYDRB8, Vol. 207, p 167-177, November 22, 1990. 3 fig, 2 tab, 45 ref.

Descriptors: *Cycling nutrients, *Interstitial water, *Israel, *Lake Kinneret, *Limnology, *Nutrient transport, *Phosphates, *Phosphorus, *Sediment chemistry, *Water chemistry, Anaerobic conditions, Calcium, Chemical transformation, Hydrogen ion concentration, Phosphorus cycle, Sampling.

Monthly samples of sediment cores from maximum depth (approximately 42 mm) in Lake Kinneret were taken from May 1988 until January 1989. The chemical composition of the interstitial and overlying water was investigated with respect to phosphate, Fe(2+), Fe(3+), Ca(2+), alkalinity and

electric conductivity, pH, pH2S and pe (electron activity) were measured by microelectrodes inserted directly into the sediment core immediately after sampling. Ion activity products of vivianite, siderite, iron sulfides, calcium-phosphorus complexes and calcium-phosphorus solid phases were calculated; in addition, calcium/phosphorus ratios for the overlying and pore water were obtained by using the potential diagram technique. Despite the fact that anoxic conditions prevail for most of the year, no control of phosphate solubility by an iron-phosphorus relationship could be found. Determination of ion activity products (IAPs), together with calculated molar calcium/phosphorus ratios, suggests that hydroxyapatite as well as surface complexes like dicalcium-phosphate are the solubility-controlling species in pore water. For the overlying water a Ca3(HCO3)3PO4 surface complex is assumed to fix the phosphorus, accompanied by a subsequent transformation of the bound phosphorus into apatite. (Author's abstract)
W91-11701

MODIFICATIONS IN HABITAT USE PATTERNS AND TROPHIC INTERRELATIONSHIPS IN THE FISH FAUNA OF AN OLIGOTROPHIC ARTIFICIAL LAKE: SAINTE CROIX (PROVENCE, FRANCE).
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
G. Brun, R. Chappaz, and G. Olivari.
Hydrobiologia HYDRB8, Vol. 207, p 197-207, November 22, 1990. 4 fig, 4 tab, 1 ref.

Descriptors: *Dam effects, *Fish populations, *Fish stocking, *France, *Limnology, *Oligotrophic lakes, *Sainte Croix Reservoir, Fish behavior, Food chains, Hydroelectric reservoirs, Seasonal variation, Species composition, Species diversity, Succession, Zooplankton.

Lake Sainte Croix is a hydroelectric reservoir on the river Verdon that came into operation about 16 years ago. The area of the lake is about 22 sq km and the volume about 767 cubic Mm. The water level drops by as much as 16 m in winter. Sante Croix is a warm monomictic oligotrophic lake. The indigenous fish fauna of the Verdon originally included eight species. Successive stocking has raised this number to seventeen. In catches made in 1976 to 1977 with 27 mm mesh nets, 80 to 90% of the fish with a body size of between 15 and 25 cm were of the four main species indigenous to the river before the dam was built: Leuciscus cephalus, Barbus fluviatilis, Chondrostoma toxostoma, Salmo trutta. Catches made at the same period with 14 mm mesh nets gave only Chondrostoma toxostoma and Leuciscus cephalus. Changes in the fish fauna were apparent from catches made in 1984 and 1987 with nets of the same mesh size. A marked demographic increase of roach, and more recently of bleak and gudgeon, all three species introduced after the construction of the dam, was noted. At the same time, decreases in catch frequency were noted for C. toxostoma, L. cephalus and B. fluviatilis in the downstream area of the lake. Stomach content analysis carried out in different seasons on the six most abundant species of the lake provided evidence on the trophic organization of the fish fauna. Niche breadth was calculated for each species using the Simpson diversity index and niche overlap by the Pianka index. Niche overlap between bleak and roach is slight or null, depending on the season. On the other hand, degree of overlap is high between roach and chub, and between roach and toxostome. The decrease in toxostome and chub frequency in the downstream area of the lake, where roach is most abundant, would appear to be a competitive exclusion phenomenon. High niche overlap between bleak and young perch partly explains the low abundance of the latter species. Other contributory factors are the scarcity of zooplankton inshore, and the scarcity of zoobenthos resulting from the drop in the water level in winter. (Author's abstract)
W91-11704

GROWTH RATE OF FOUR FRESHWATER ALGAE IN RELATION TO LIGHT AND TEMPERATURE.
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
A. Dauta, J. Devaux, F. Piquemal, and L. Boumnich.
Hydrobiologia HYDRB8, Vol. 207, p 221-226, November 22, 1990. 6 fig, 1 tab, 29 ref.

Descriptors: *Algae, *Algal growth, *Light intensity, *Mathematical models, *Phytoplankton, Chlorophyta, Comparison studies, Diatoms, Periodicity, Photoperiod, Seasonal distribution, Species composition, Temperature effects.

Four freshwater phytoplankton were studied in monospecific culture: Chlorella vulgaris, Fragilaria crotonensis, Staurastrum pingue and Synechocystis minima. Experimental determination of the growth rate over a wide range of light intensities (5 to 800 microm E/sq m/sec, 15/9 light/dark photoperiod) and associated to optimal conditions of light and temperature) were used for a three-equation model to describe the growth rate versus light intensity response of a non-nutrient-limited culture. The variation between maximal growth rate and saturating irradiance indicate the interdependence between growth rate, irradiance and temperature. Simulation of seasonal periodicity and changes in species composition serves both theoretical and practical objectives. (Brunone-PTT)
W91-11706

ALKALINE PHOSPHATASE ACTIVITY FLUCTUATIONS AND ASSOCIATED FACTORS IN A EUTROPHIC LAKE DOMINATED BY OSCILLATORIA RUBESCENS.
Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Inst. de Limonologie.
For primary bibliographic entry see Field 5C.
W91-11708

EFFECTS OF SELECTIVE FISH PREDATION ON THE HORIZONTAL DISTRIBUTION OF PELAGIC CLADOCERA IN A SOUTHERN FRENCH RESERVOIR.
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
D. Pont, and J. Amrami.
Hydrobiologia HYDRB8, Vol. 207, p 259-267, November 22, 1990. 7 fig, 1 tab, 33 ref.

Descriptors: *Fish food organisms, *France, *Limnology, *Oligotrophic lakes, *Predation, *Sainte Croix Reservoir, *Waterfleas, *Zooplankton, Population dynamics, Reservoirs, Seasonal variation, Size selection, Spatial distribution, Species composition, Thermal stratification.

A four-year study showed a clear seasonal succession of species within the cladoceran community of the large, oligotrophic Sainte Croix reservoir (southeast France). Diphanosoma brachyurum and Ceriodaphnia pulchella were strictly limited to the warm stratified period (July to October), whereas Bosmina longirostris and Bosmina coregoni were dominant during spring and autumn. Daphnia longispina was the only species to occur throughout the year with higher densities in spring. In spring and late autumn, the discharge of the inflowing river Verdon was high and the abundance of all species showed a gradient over the whole lake with lower densities close to the inflow. During the stratified period, water inflow was very low and species showed different patterns. Densities of the small form Ceriodaphnia pulchella were similar all along the long axis of the lake, whereas Daphnia densities were significantly higher near the dam. The distribution pattern of Diaphanosoma, an intermediate-sized species, showed similar trends to that of Daphnia. The only planktivorous fish in the pelagic zone, the bleak (Alburnus alburnus), fed mostly on large-bodied species (>1.0 mm) and was more abundant close to the inflow current. A comparison between the length frequency distribution of cladocera upstream and downstream provided a clear demonstration of the effects of size-selective predation on prey populations. Finally, strong interrelationships exist between spatial heterogeneity, long-term development of the zooplankton community, and the indirect effects of predation. (Author's abstract)
W91-11711

SEASONAL VARIATION IN THE INTERACTIONS BETWEEN PISCIVOROUS FISH, PLANKTIVOROUS FISH AND ZOOPLANKTON IN A SHALLOW EUTROPHIC LAKE.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
J. Vijverberg, M. Boersma, W. L. T. van Densen, W. Hoogenboezem, and E. H. R. R. Lammens.
Hydrobiologia HYDRB8, Vol. 207, p 279-286, November 22, 1990. 5 fig, 1 tab, 26 ref.

Descriptors: *Eutrophic lakes, *Fish behavior, *Fish populations, *Food chains, *Limnology, *Trophic level, *Zooplankton, Bream, Organic matter, Pikeperch, Seasonal variation, Smelt, Water temperature, Waterfleas.

The interaction between the higher trophic levels in a shallow eutrophic lake were studied during the course of a year. Three fish species dominated the main pathways of organic matter flow within the system: the predominantly planktivorous bream (Abramis brama), the obligate planktivorous smelt (Osmerus eperlanus), and the piscivorous pikeperch (Stizostedion lucioperca). Of the thirteen common zooplankton taxa, Daphnia hyalina and cyclopoid copepods were utilized most by the planktivorous fish, while the large production of small cladocerans is almost unutilized. The seasonal variations of production and consumption are large, and mainly affected by seasonal water temperature variation. The production of 0+ smelt is efficiently utilized by the pikeperch. As the most important zooplankton consumers, as well as the most important prey, 0+ fish play a key role in the Tjeukemeer food web. (Author's abstract)
W91-11713

ADVANTAGES OF DISTINGUISHING THE ACTIVE FRACTION IN BACTERIOPLANKTON ASSEMBLAGES: SOME EXAMPLES.
Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Inst. de Limonologie.
For primary bibliographic entry see Field 5A.
W91-11715

BIOGEOCHEMISTRY OF ORGANIC MATTER IN LAKE GENEVA: I--PARTICULATE HYDROCARBONS AS BIOGENIC AND ANTHROPOGENIC MOLECULAR MARKERS.
Paris-6 Univ. (France). Lab. de Physique et Chimie Marines.
P. Scribe, J. S. Ngoumbi-Nzouzi, C. Fuche, C. Pepe, and A. Saliot.
Hydrobiologia HYDRB8, Vol. 207, p 319-331, November 22, 1990. 3 fig, 3 tab, 33 ref.

Descriptors: *Biogeochemistry, *Hydrocarbons, *Lake Geneva, *Limnology, *Organic matter, *Particulate matter, *Switzerland, Algal blooms, Animal behavior, Carbon, Epilimnion, Hypolimnion, Particle size, Phytoplankton, Seasonal variation, Sedimentation, Spatial distribution, Zooplankton.

A study of the biogeochemistry of organic matter in Lake Geneva at a central station was carried out from November 1985 to September 1986. The seasonal variability of particulate hydrocarbons was investigated in the epilimnion and hypolimnion, focusing on specific periods such as high phytoplankton productivity and rising herbivorous zooplankton activity (May 1986), clearness of waters (June 1986) and intense mixing of waters (February 1986). Analysis of non-aromatic hydrocarbons (NAH) indicated that their major source is the autochtonous phytoplankton. A spring bloom of nanoplankton remained dominant during summer and fall. These biological events were correlated with an increase of biogenic NAH, particularly n-alkane and alkene concentrations. n-Alkane distributions maximized at n-C17 or n-C29; the nC17/nC29 ratio varied in surface water from 2.8 in May to 0.06 in November of the preceding year, reflecting phytoplankton dominant species. Values of NAH/POC, n-alkanes/POC, alkenes/POC and pristane/phytane ratios underwent seasonal and vertical variations. NAH, n-alkane and alkene enrichment in the hypolimnion particles was interpreted to be a result of zooplankton migration. A

series of 37 monoenes and polyenes having from 15 to 31 carbon atoms, originating from planktonic sources, were noted in the particulate matter by gas chromatography/mass spectrometry. These molecules were distributed in particle sizes of >200 microm, 200 to 60 microm, and <60 microm at two different periods of the biological cycle, May and June 1986. Low level inputs from terrestrial higher plants were evident in particles; the value of the Carbon Preference Index in the carbon range 23 to 35 was less than 2.8. Typical anthropogenic PAH, such as benzofluoroanthene and dibenzo(a)anthracene, were found at a low level. The absence of hopane-type hydrocarbons, except in November 1985 and September 1986, and typical combustion PAH associated with particles indicated high temperature pyrolytic contaminants rather than petroleum-derived compounds. (Author's abstract)
W91-11718

DISCREPANCIES BETWEEN A COLORIMETRIC AND ISOTOPIC METHOD FOR MEASURING NITRATE UTILIZATION IN NUTRIENT-DEPLETED WATERS: IMPLICATIONS FOR THE DESIGN OF EXPERIMENTAL PROTOCOLS IN NEW PRODUCTION STUDIES.
Centre d'Oceanologie de Marseille (France).
G. Slawyk, P. Raimbault, and V. Gentilhomme.
Hydrobiologia HYDRB8, Vol. 207, p 333-339, November 22, 1990. 1 fig, 1 tab, 30 ref.

Descriptors: *Colorimetry, *Cycling nutrients, *Experimental design, *Laboratory methods, *Nitrates, *Nutrient concentrations, *Water analysis, Biomass, Isotopic tracers, Organic nitrogen, Plankton, Regression analysis, Separation techniques.

Colorimetric analyses of nitrate disappearance from seawater have been compared with isotopic analyses of nitrogen-15 labeled nitrate incorporation into particulate matter. The slope (1.41) of a regression line calculated from nineteen sample pairs gathered during six time series experiments and 2 single end point incubations showed that nitrate incorporation is positively related to changes in nitrate concentration but accounts for only 71% of nitrate disappearance. Nitrogen-15 isotope dilution as a consequence of nitrification, if any, would not fully explain discrepancies between the two analytical procedures. A further possible mechanism responsible for the imbalance between the nitrate incorporation and nitrate disappearance rates suggests losses of nitrogen-15 label from plankton biomass to an unanalyzed pool (possibly dissolved organic nitrogen) which increase (up to 65%) with incubation time. The lack of nitrogen-15 mass balance calls for the need to consider additional nitrogen pools in nitrogen-15 budgets of isotope experiments and not only substrate and biomass pools as has been done so far. (Author's abstract)
W91-11719

PALEOCLIMATIC HISTORY OF DEVILS LAKE, NORTH DAKOTA: FINAL REPORT.
Mackay School of Mines, Reno, NV.
W. B. Lyons.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-168963. Price codes: A03 in paper copy, A01 in microfiche. Final Report, 1991. 28p, 2 fig, 5 tab, 44 ref. Based on dissertation research of R. M. Lent. USGS Contract No. 14-08-0001-G1655.

Descriptors: *Geochemistry, *Lake sediments, *Lakes, *Limnology, *Paleoecology, *Paleohydrology, Aquifers, Devils Lake, Groundwater, History, North Dakota, Paleoclimatology, Spiritwood aquifer, Time series analysis, Water level.

Analyses were made on a series of sediment, porewater and groundwater samples in and around the Devils Lake, N. D. region in order to: (1) establish a short term (i.e. 500 yr) climatic record; (2) determine the relationship between hydrologic forcing and the lake's biological response; (3) calculate a chemical budget for the lake waters; and (4) understand the influence of the Spiritwood Aquifer on the overall lake system. Data indicate that the sediments of the lake provide a detailed paleohydrologic and paleobiological record of the lake. Biogenic silica correlates extremely well with changes in lake level and therefore represents an extremely sensitive indicator of the paleohydrology of the drainage basin. Time series analyses of the sediment data demonstrate a close correlation between in-situ lake biological activity and the 11 yr sun spot cycle. Geochemical budget of the lake suggests that the lake sediments are an important source of solutes to the lake waters especially at high stand periods. The groundwater analyses show that the major recharge to the Spiritwood Aquifer is probably from winter precipitation. (USGS)
W91-11910

PRELIMINARY REPORT ON THE HYDROGEOLOGY OF LAKE FIVE-O AND VICINITY.
Geological Survey, Tallahassee, FL. Water Resources Div.
W. J. Andrews, J. P. Oliveros, and J. J. Collins.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4148, 1990. 1 sheet, 13 fig, 2 tab, 9 ref.

Descriptors: *Acid rain, *Acid rain effects, *Florida, *Geohydrology, *Seepage lakes, *Sinkholes, *Surface-groundwater relations, Geochemistry, Karst, Lake Five-O, Limnology, Water quality.

Lake Five-O is a seepage lake in north-central Bay County in the panhandle of Florida. The lake, like most others in the area, has a higher head than that of the underlying Upper Floridan aquifer. Lake Five-O and similar lakes lose water to the Upper Floridan aquifer through underlying breaches in the lower confining unit of the surficial aquifer. Since February 1989, the Florida Office of the U.S. Geological Survey, participating in a national study on the effects of acidic precipitation, has been measuring climatologic data at two stations, one adjacent to the lake and the other on the lake surface, for the purpose of formulating a hydrologic budget for the lake system. This report is a summary of hydrogeologic, bathymetric, and water quality data gathered at Lake Five-O since July 1988. (USGS)
W91-11920

INDIVIDUAL PARTICLE ANALYSIS OF SUSPENDED MATERIALS IN ONONDAGA LAKE, NEW YORK.
State Univ. of New York, Syracuse. Coll. of Environmental Science and Forestry.
D. L. Johnson, J. Jiao, S. G. DosSantos, and S. W. Effler.
Environmental Science and Technology ESTHAG, Vol. 25, No. 4, p 736-744, April 1991. 7 fig, 3 tab, 29 ref.

Descriptors: *Limnology, *New York, *Onondaga lake, *Particulate matter, *Suspended solids, *Water pollution effects, *Water pollution sources, Calcium carbonate, Chemical precipitation, Chemical properties, Eutrophic lakes, Particle analysis, Phytoplankton, Storm runoff.

The chemical and physical characteristics of the particles of the near-surface waters of polluted, hypereutrophic, Onondaga Lake, NY, were observed by individual particle analysis techniques for the spring to fall interval of 1987. Strong temporal variations were documented for the projected particle area per unit volume (PAV) and the relative contribution that six chemical groupings of particles made to the overall assemblage of particles--(1) 'organic' detritus, (2) calcium carbonate precipitate, (3) quartz plus diatoms, (4) 'clay particles', (5) calcium precipitate on clay or silica 'nucleus' and (6) everything else. These dynamics were regulated largely by (1) the composition and level of phytoplankton growth, (2) tributary loading of particles, particularly after runoff events, and (3) the precipitation of calcium carbonate. Approximately 85% of the PAV was associated with in-lake processes and 15% was derived from tributary transport. Approximately 25% of the internally produced PAV was related to calcium carbonate precipitation; the remainder was associated with biological production. (Author's abstract)
W91-11966

DNA SYNTHESIS AND TRITIATED THYMIDINE INCORPORATION BY HETEROTROPHIC FRESHWATER BACTERIA IN CONTINUOUS CULTURE.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
F. M. Ellenbroek, and T. E. Cappenberg.
Applied and Environmental Microbiology AEMIDF, Vol. 57, No. 6, p 1675-1682, June 1991. 3 fig, 4 tab, 38 ref.

Descriptors: *Aquatic bacteria, *Culturing techniques, *DNA, *Limnology, *Thymidine, Aquatic environment, Bacterial growth, Bacterial physiology, Lake Vechten, Microbiological studies, Radioactive tracers, The Netherlands, Tritium.

Continuous cultivation of heterotrophic freshwater bacteria was used to assess the relationship between DNA synthesis and tritiated thymidine incorporation. The bacteria were grown on a yeast extract medium with generation times of 0.25 to 3.7 days. In six different continuous cultures, each inoculated with a grazer-free mixed bacterial sample from Lake Vechten (The Netherlands), tritiated thymidine incorporation into a cold trichloroacetic acid precipitate and bacterial cell production were measured simultaneously. Empirical conversion factors were determined by a division of both parameters. They ranged from 0.25 to 1.31 quintillion cells/mol of tritiated thymidine. In addition, DNA concentrations were measured by fluorometry with Hoechst 33258. The validity of this technique was confirmed. Down to a generation time of 0.67 day, bacterial DNA content showed little variation, with values of 3.8 to 4.9 fragments of DNA/cell. Theoretical conversion factors, which can be derived from DNA content under several assumptions, were between 0.26 and 0.34 quintillion cells/mol of thymidine. Isotope dilution was considered the main factor in the observed discrepancy between the conversion factors. In all experiments, a tritiated thymidine concentration of 20 nM was used. Control experiments indicated maximum incorporation at this concentration. It was therefore concluded that the observed difference resulted from intracellular isotope dilution which cannot be detected by current techniques for isotope dilution analysis. (Author's abstract)
W91-12012

SURVIVAL OF AEROMONAS SALMONICIDA IN LAKE WATER.
Freshwater Biological Association, Ambleside (England).
J. A. W. Morgan, P. A. Cranwell, and R. W. Pickup.
Applied and Environmental Microbiology AEMIDF, Vol. 57, No. 6, p 1777-1782, June 1991. 5 fig, 1 tab, 30 ref.

Descriptors: *Aeromonas, *Aquatic bacteria, *Bacterial analysis, *Fish diseases, *Limnology, Bacteria, Bacterial growth, DNA, Flow cytometry, Microbiological studies, RNA.

The survival of Aeromonas salmonicida subsp. salmonicida in lake water was investigated by using a variety of techniques, including: acridine orange epifluorescence, respiration, cell culture, cell revival, flow cytometry, plasmid maintenance, and membrane fatty acid analysis. During a 21-day study, A. salmonicida became nonculturable in sterile lake water samples. Flow cytometry and direct microscopy indicated that cells were present. Although the nonculturable cells could not be revived, the recovery method did indicate that the presence of low numbers of culturable cells within samples could produce misleading results. Plasmid DNA, genomic DNA, and RNA were maintained in the nonculturable cells; in addition, changes in the fatty acid profiles were also detected. Although viability could not be proven, it was shown that the morphological integrity of nonculturable cells was maintained. (Author's abstract)
W91-12014

SEASONAL VARIABILITY IN THE SENSITIVITY OF FRESHWATER PHYTOPLANKTON COMMUNITIES TO A CHRONIC COPPER STRESS.
Miami Univ., Oxford, OH. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-12016

TOXICITY OF COPPER TO THE GREEN ALGA, CHLAMYDOMONAS REINHARDTII (CHLOROPHYCEAE), AS AFFECTED BY HUMIC SUBSTANCES OF TERRESTRIAL AND FRESHWATER ORIGIN.
Miami Univ., Oxford, OH. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-12017

PROOXIDANT AND ANTIOXIDANT MECHANISMS IN AQUATIC ORGANISMS.
Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5C.
W91-12021

AQUATIC HYPHOMYCETE COMMUNITIES IN THE RIVER TEIGN: IV. TWIG COLONIZATION.
Illinois Univ., Urbana. Dept. of Botany.
C. A. Shearer, and J. Webster.
Mycological Research, Vol. 95, No. 4, p 413-420, April 1991. 9 fig, 3 tab, 39 ref.

Descriptors: *Aquatic fungi, *Colonization, *Ecological distribution, *Stream biota, *Teign River, *Woody debris, Acidity, Alder trees, Downstream, England, Incubation, Membrane filters, Oak trees, Species diversity, Spores, Stream classification, Succession, Upstream.

Studies on the taxonomy and ecology of aquatic hyphomycetes have rarely considered their occurrence on wood. In a study of the longitudinal and temporal distribution of aquatic hyphomycetes in the river Teign in Devon, England, corticated and decorticated twigs of alder and oak were placed at five sites along a gradient of stream order and pH. After 2 and 6 months of submersion, twigs were examined directly and then placed individually in bubble chambers to simulate stream conditions. The water was membrane filtered and aquatic conidia on filters were identified and quantified. The mean number of conidia per twig varied from 0 to over 700,000/48 h incubation period and was generally greater from samples at downstream than from upstream sites. Only three species, Heliscus lugdunensis, Mycocentrospora acerina, and Tricladium spendens, occurred frequently throughout the river. Longitudinal distribution patterns varied among species, with the majority of species occurring from the third site and downstream. Species replacements occurred over time. Species diversity and H' diversity varied among sites and peaked at the penultimate site rather than increasingly linearly in a downstream direction. More species of aquatic hyphomycetes were detected with bubble chamber incubation than with direct examination and moist chamber incubation; the converse was true for ascomycetes. Woody debris may initially trap fewer species than leaves, but by revealing successive layers of substrate over time, may be colonized by many species successively. (Author's abstract)
W91-12040

CHARACTERISTICS OF THE CHEMICAL COMPOSITION OF WATER IN LAKES OF NORTH POLAND (CHARAKTERYSTYKA CHEMICZNEGO SKLADU WODY W JEZIORACH POLNOCNEJ POLSKI).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 5B.
W91-12061

APPLICATION OF UNDERWATER LIGHT MEASUREMENTS FOR ESTIMATION OF SUN RADIATION ENERGY FLUXES IN NATURAL WATERS.
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
R. K. Kalchev.
Khidrobiologiia KHIDD9, Vol. 36, p 49-55, January 1991. 2 fig, 3 tab, 8 ref.

Descriptors: *Light intensity, *Light penetration, *Photosynthesis, *Radiation, *Reservoirs, Bulgaria, Energy transfer, Irradiation, Mathematical studies.

Light measurements were performed underwater in the Iskar Reservoir using a universal pyranometer under sunny and cloudy conditions. Global sun radiation (GR) and photosynthetically active sun radiation (PAR) energy fluxes were also measured underwater to determine the best time for underwater light measurements in relation to sun radiation energy fluxes in natural waters. On a day with variable cloudiness the PAR/GR ratio varied considerably (0.28-0.54), while on a bright sunny day it was in the range of 0.30-0.35. The sum of squares of deviations (SSDs) on a bright day were smaller than on a day with variable cloudiness. The optimum time for underwater measurements by means of which the most exact estimation of a daily energy integral sums was shifted to the more sunny half of a day with variable cloudiness, but on a bright sunny day the optimum time for measurements would be about noon. These estimations were confirmed by meteorological data which showed that it was calm on the water until noon, but became windy on the reservoir in the afternoon. (Geiger-PTT)
W91-12065

MINERALIZATION OF DISSOLVED ORGANIC PHOSPHORUS FROM A SHALLOW EUTROPHIC LAKE.
Agriculture and Food Science Centre, Belfast (Northern Ireland). Food and Agricultural Microbiology Research Div.
For primary bibliographic entry see Field 5B.
W91-12091

PHYSICAL AND CHEMICAL CHARACTERS, PHYTOPLANKTON AND PRIMARY PRODUCTION OF EZEQUIEL RAMOS MEXIA RESERVOIR (ARGENTINA).
Universidad Nacional de La Plata (Argentina). Inst. de Limnologia.
A. Mariazzi, V. Conzonno, R. Echenique, and H. Labollita.
Hydrobiologia HYDRB8, Vol. 209, No. 2, p 107-116, February 1991. 10 fig, 4 tab, 21 ref.

Descriptors: *Argentina, *Ezequiel Ramos Mexia Reservoir, *Limnology, *Phytoplankton, *Primary productivity, *Reservoirs, Chlorophyll a, Chlorophyta, Cyanophyta, Cycling nutrients, Diatoms, Limay River, Retention time, Trophic level.

Ezequiel Ramos Mexia Reservoir was formed in 1972 by damming the Limay River (Argentina). The reservoir has a surface area of 816 sq km, volume of 20,200 cu hm, and mean depth of 24.7 m. The distribution of physical and chemical variables in this reservoir in both space and time was investigated. The reservoir's waters are soft, poor in nutrients, and have low transparency, which greatly depresses primary production. The phytoplankton consists of 79 taxa, with Bacillariophyceae, Cyanophyta, and Chlorophyta alternately dominant. Chlorophyll a was always low and never exceeded 3 mg/cu m. Overall, the variables surveyed characterize the reservoir as oligo-, to mesotrophic. A low concentration of nutrients and short water residence time are the main factors responsible for this low trophic level. (Rochester-PTT)
W91-12092

PORTABLE CHAMBER FOR MEASURING ALGAL PRIMARY PRODUCTION IN STREAMS.
Colgate Univ., Hamilton, NY. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W91-12094

PLANKTONIC BACTERIAL BIOMASS AND SEASONAL PATTERN OF THE HETEROTROPHIC UPTAKE AND RESPIRATION OF GLUCOSE AND AMINO ACIDS IN THE SHALLOW SANDPIT LAKE OF CRETEIL (PARIS SUBURB, FRANCE).
Ecole Normale Superieure, Paris (France). Lab. d'Ecologie.
J. Garnier, and D. Benest.
Hydrobiologia HYDRB8, Vol. 209, No. 3, p 191-202, February 15, 1991. 6 fig, 2 tab, 73 ref.

Descriptors: *Bacterial productivity, *Creteil Lake, *France, *Heterotrophic bacteria, *Limnology, *Seasonal variation, Biomass, Carbon radioisotopes, Growth kinetics, Isotope studies, Mineralization, Organic matter, Tracers.

Heterotrophic bacteria decompose organic matter and synthesize biomass that is consumable by microflagellates and other bacteriovores. Biomass and activity of planktonic bacteria were investigated for 1 yr in a shallow sandpit lake (Creteil Lake, in a Paris suburb, France). The shallowness of the lake helped keep the water column homogeneous regarding bacterioplankton. Small free-living bacteria (0.03 cu micrometer/cell) dominated the population throughout the study period. Bacterial abundances varied from 1 to 11 million cells/ml. Kinetic parameters (Vmax, K+S, and T) were determined with 14C-labeled compounds (glucose and amino acid mixture). Vmax values were high, averaging 0.056 and 0.050 microgram C/l/hr for glucose and amino acids, respectively. Maximal Vmax values were observed in summer at the highest temperatures and in early spring. T values were much greater in winter. K+S values were significantly higher for amino acids (3 microgram C/l) than for glucose (1 microgram C/l). A low percentage of mineralization (about 25% for both tracers) could be the expression of high growth efficiency expected when bacteria are growing at the expense of low molecular weight compounds such as phytoplankton exudates. (Author's abstract)
W91-12095

MESH-SIZE EFFECTS ON DRIFT SAMPLE COMPOSITION AS DETERMINED WITH A TRIPLE NET SAMPLER.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W91-12096

CASE OF UNUSUALLY HIGH OXYGEN DEMAND IN A EUTROPHIC LAKE.
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W91-12097

LIMNOLOGICAL RECONNAISSANCE OF LAKE TEBENQUICHE, SALAR DE ATACAMA, CHILE.
Universidad Catolica de Valparaiso (Chile). Inst. de Biologia.
L. R. Zuniga, V. Campos, H. Pinochet, and B. Prado.
Hydrobiologia HYDRB8, Vol. 210, No. 1/2, p 19-24, March 1991. 4 fig, 5 tab, 6 ref. Project No. DG1-UCV, FONDECYCT 643/88.

Descriptors: *Chile, *Lake Tebenquiche, *Lakes, *Limnology, *Saline lakes, Aquatic bacteria, Brine shrimp, Chlorides, Macrophytes, Oscillatoria, Playas, Sodium, Sulfates, Swamps.

In the Salar de Atacama (Antofagasta district of Chile), surface and ground water flow within closed plains towards the salares (salt-encrusted playas), saline swamps, and salt lakes. A number of investigations in the area of Salar de Atacama have involved studies of the biological and chemical features of Lake Tebenquiche, which is situated in the interior of the Salar. Tebenquiche is hypersaline, with practically anoxic waters dominated by sodium and chloride ions but with high concentrations of sulfate. The lake is surrounded and invaded by macrophytes, dominated by Scirpus olmeyi

and Juncus, which provide organic material for the formation of bacterial mats. The fauna of limnetic crustaceans consists almost exclusively of Artemia salina. The most important genera of bacteria are Marinomonas, Halobacterium, Acinetobacter, and the sulfur reducers Vibrio and Bacillus. The Cyanobacteria are represented exclusively by Oscillatoria. (Rochester-PTT)
W91-12099

CHEMISTRY AND CRUSTACEAN ZOOPLANKTON OF THE SEEWINKEL PANS: A REVIEW OF RECENT CONDITIONS.
Burgenlaendisches Landesmuseum, Eisenstadt (Austria).
H. Metz, and L. Forro.
Hydrobiologia HYDRB8, Vol. 210, No. 1/2, p 25-38, March 1991. 4 fig, 5 tab, 40 ref.

Descriptors: *Austria, *Land use, *Saline lakes, *Water chemistry, *Zooplankton, Alkalinity, Conductivity, Environmental effects, Hydrogen ion concentration, Potassium, Seewinkel Region, Sodium, Species diversity.

Many shallow saline pans are located in the Seewinkel, a region in eastern Austria between Neusiedlersee and the Hungarian border. A number of shallow pans were investigated between May 1982 and May 1985. Chemical and zooplankton samples were obtained monthly. A general feature of the water chemistry of the pans is the dominance of Na/K over Ca/Mg. Conductivity in the pans ranged from < 2000 microS/cm to 30,000 microS/cm. High alkalinity with a dominance of sodium was an obvious feature, with SBV ranging from 4.2 to over 90. pH usually ranged from 8 to 10. Between 1982 and 1985 some 35 species of Branchiopoda and Copepoda were found in the 32 pans studied. The number of species recorded per pan varied from 2-18 with > 10 being found in the larger, permanent pans. The most important discovery from these studies was that some clear changes have taken place since earlier investigations. Both the number and nature of the water bodies and chemical and biological characteristics have changed, mostly as a direct result of human activities. Many smaller pans have disappeared. (Rochester-PTT)
W91-12100

CHINESE AND MONGOLIAN SALINE LAKES: A LIMNOLOGICAL OVERVIEW.
Hong Kong Univ. Dept. of Zoology.
W. D. Williams.
Hydrobiologia HYDRB8, Vol. 210, No. 1/2, p 39-66, March 1991. 5 fig, 9 tab, 118 ref.

Descriptors: *China, *Lakes, *Land use, *Limnology, *Mongolia, *Saline lakes, *Tibet, Birds, Brine shrimp, Ctenocladus, Environmental effects, Fish, Geology, Macroinvertebrates, Macrophytes, Salinity, Wind effects.

More than half of China's lakes are saline (i.e., > 3 g/L). Most salt lakes are in northwestern China (Tibet, Qinghai, Sinkiang, and Inner Mongolia). The lakes have been formed by tectonic movements, eolian activity, and deflation and they range in size from large and deep to small and shallow. Dimictic thermal patterns prevail in deep lakes, polymictic patterns in shallow ones. The highest salinity recorded is 555 g/L. The salinity of Qinghai Lake, the largest Chinese salt lake, is 14 g/L, but mean lake salinity on the northern Tibetan plateau is about an order of magnitude greater. There are no bird or fish species confined to salt lakes, though many are associated with lakes of low or moderate salinity. Artemia occurs widely inland and in coastal salt pans, but is the only macroinvertebrate in highly saline lakes. In lakes of only moderate salinity, invertebrate communities comprise widespread halotolerant freshwater forms and halophiles, some regionally endemic. Submerged and emergent macrophytes occur in lakes of low salinity, but phytoplankton species are more halotolerant. Ctenocladus circinatus, a green alga, is known from a Tibetan salt lake with a salinity of 200 g/L. There is a dearth of basic limnological information on Chinese and Mongolian salt lakes. The natural existence of many of the lakes appears to be threatened by decreased inflows largely the result of human impact on catchments. (Author's abstract)
W91-12101

COMMENTS ON THE SO-CALLED SALT LAKES OF GREENLAND.
Adelaide Univ. (Australia). Dept. of Zoology.
W. D. Williams.
Hydrobiologia HYDRB8, Vol. 210, No. 1/2, p 67-74, March 1991. 2 fig, 4 tab, 46 ref.

Descriptors: *Greenland, *Limnology, *Saline lakes, *Water chemistry, Cations, Conductivity, Ecology, Magnesium, Sodium, Species diversity.

Most athalassic standing waters of Greenland have conductivities of < 1000 micromhos. Those with higher conductivities have salinities mostly < 3 g/L and they generally are referred to as 'saline' within Greenland. Only a single water body is known with a conductivity > 10,000 micromhos. Saline waters have Na and Mg as dominant cations, with low concentrations of sulfate. Their biota is very depauperate and apparently comprises a few salinity-tolerant elements of the local freshwater biota. There is no regional assemblage of halophilic species. (Author's abstract)
W91-12102

INLAND SALT WATERS OF SOUTHERN AFRICA.
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Zoology and Entomology.
M. T. Seaman, P. J. Ashton, and W. D. Williams.
Hydrobiologia HYDRB8, Vol. 210, No. 1/2, p 75-91, March 1991. 3 fig, 5 tab, 100 ref.

Descriptors: *Africa, *Botswana, *Limnology, *Namibia, *Saline lakes, *South Africa, Birds, Brine shrimp, Cyanophyta, Halophytes, Invertebrates, Macrophytes, Salinity, Species diversity.

Inland lakes are distributed widely in southern Africa. They are particularly common in South Africa, but many occur in Namibia and Botswana. All are shallow and most are ephemeral, with salinities that are not very high (mostly < 50 g/L). Fringing zones of halophytes or submerged macrophytes are neither well-developed nor taxonomically diverse. The Cyanobacteria, especially Nodularia spumigena, often dominate the phytoplankton. The fauna of the Makgadikgadi area (northeast Botswana) is diverse and is similar to that of East African salt lakes. The aquatic fauna of salt water south of the Makgadikgadi Basin, on the other hand, is extremely depauperate, has no well-defined assemblage confined to saline waters, and appears mostly to comprise tolerant freshwater forms. Lovenula falcifera and Metadiaptomus transvaalensis (diaptomid copepods), Moina micrura (Cladocera), and Brachionus plicatilis (Rotifera) are the frequently encountered zooplankton species. A few species of insects (Anisops sp., beetles, chironomids, and ephydrids) are the principal non-planktonic macroinvertebrates. Artemia 'salina' occasionally is present, but may be an introduced form. The avifauna, in contrast to the aquatic macroinvertebrate fauna, is rich, with greater and lesser flamingo often common. (Author's abstract)
W91-12103

REVIEW OF THE SALT SENSITIVITY OF THE AUSTRALIAN FRESHWATER BIOTA.
Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology.
For primary bibliographic entry see Field 5G.
W91-12104

SALINITY TOLERANCES OF FOUR SPECIES OF FISH FROM THE MURRAY-DARLING RIVER SYSTEM.
Adelaide Univ. (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-12105

LONGITUDINAL DISTRIBUTION OF MACROINVERTEBRATES SUBJECT TO SALINIZATION.
Adelaide Univ. (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-12106

EFFECTS OF MIXING AND SILICA ENRICHMENT ON PHYTOPLANKTON SEASONAL SUCCESSION.
Minnesota Univ.-Duluth. Dept. of Biology.
A. Klemer, and J. Barko.
Hydrobiologia HYDRB8, Vol. 210, No. 3, p 171-181, March 1991. 7 fig, 2 tab, 36 ref.

Descriptors: *Ecological effects, *Nutrients, *Phytoplankton, *Seasonal variation, *Succession, Agricultural runoff, Biomass, Chlorophyta, Cryptophyta, Cyanophyta, Diatoms, Dinoflagellates, Eau Galle Reservoir, Ecology, Lake restoration, Limnology, Nitrogen, Phosphorus, Wisconsin.

The Eau Galle Reservoir, situated in west-central Wisconsin, is a eutrophic body of water that receives agricultural runoff and is, therefore, a candidate for restoration. During the summer of 1983, cryptophytes, diatoms, cyanophytes, and the dinoflagellate Ceratium hirundinella were most prominent among the phytoplankton of Eau Galle Reservoir. In the open water, cryptophytes and diatoms peaked in the spring, cyanophytes were most successful in the early summer, and Ceratium dominated in mid-July and early August. In general, the sequence of events corresponded quite closely to the model of seasonal succession developed by the Plankton Ecology Group of the International Society of Limnology. To a large extent, the same pattern held in four experimental water columns. Departures from the model involved the role of specific nutrients in diatom and cyanophyte periodicity. Diatoms began to yield to cyanophytes in late spring despite intermittent mixing and silica enrichment. Although capable of buoyancy regulation and thus well adapted to stable water columns, cyanophytes had greater increases in biomass in mixed columns. Also, in those columns they were most successful during a period of intermittent mixing. Cyanophyte success varied inversely with TN:TP ratios during the period of intermittent mixing, but not subsequently. By mid-July, Ceratium dominated the phytoplankton of every column except that of a mixed column in which conditions favored cyanophytes and large diatom species. (Author's abstract)
W91-12107

PREDICTION OF WATER TEMPERATURES IN CHALK STREAMS FROM AIR TEMPERATURES.
Institute of Freshwater Ecology, Wareham (England). River Lab.
A. P. Mackey, and A. D. Berrie.
Hydrobiologia HYDRB8, Vol. 210, No. 3, p 183-189, March 1991. 1 fig, 3 tab, 23 ref.

Descriptors: *Air temperature, *England, *Mathematical models, *Water temperature, Aquatic insects, Chalk streams, Limnology, Model studies, Performance evaluation, Prediction, Regression analysis.

Water temperature is considered to be of major evolutionary significance for aquatic insects and has been considered to be a dominant factor regulating the composition of aquatic insect communities. The water temperatures of four English chalk streams with a large groundwater component in their discharge were studied. Simple linear regression models were used to describe mean monthly water temperature a function of mean monthly air temperature. There were not significant between-year differences within rivers in the Lambourn, Winterbourne, and Tadnoll. For the Frome, only one year out of the eight studied differed significantly from the others. Further analysis revealed that there were no significant differences among the Lambourn, Winterbourne, and Tadnoll, and that the relationship between maximum monthly water temperature and air temperature was best described by the equation y = 4.29 x 0.55x. Using

this pooled equation to predict river temperatures for the three rivers studied gave mean deviations of less than 1 C from the observed temperatures. Linear regression of this type appears to be sufficiently accurate to predict the thermal regimes of rivers for a variety of limnological purposes. They also can be used to predict the temperature response of chalk streams to increased air temperatures that may be produced by climatic change. The results predict that chalk streams would show less increase in temperature than other running waters under these circumstances. (Author's abstract)
W91-12108

METHANE PRODUCTION IN MEROMICTIC ACE LAKE, ANTARCTICA.
Tasmania Univ., Hobart (Australia). Dept. of Agricultural Science.
P. D. Franzmann, N. J. Roberts, C. A. Mancuso, H. R. Burton, and T. A. McMeekin.
Hydrobiologia HYDRB8, Vol. 210, No. 3, p 191-201, March 1991. 3 fig, 3 tab, 45 ref.

Descriptors: *Ace lake, *Antarctica, *Limnology, *Meromictic lakes, *Methanogenesis, Carbon radioisotopes, Isotope studies, Metabolism, Methane, Methane bacteria, Sulfates, Water density, Water temperature.

Ace Lake is a meromictic lake in the Vestfold Hills, Antarctica. The lake has a maximum depth of 24.7 m and is covered by ice for > 9 mo/yr. Methane occurred in the monimolimnion of Ace Lake at depths > 11 m. Although the water of the lake was of approximately marine salinity, bottom waters were depleted of sulfate (< 1 mmol/l). The temperature of the bottom waters of the lake were constantly between 1 C and 2 C. Rates of methanogenesis from 14-C-labeled precursors (bicarbonate, formate, and acetate) were determined in time course experiments with the detection of 14-CH4 produced by a gas chromatography-gas proportional counting system. Rates of 14-CH4 production were difficult to determine as the reactions always were near the limit of detection. Reliable determinations of rates of methanogenesis at some depths using some precursors were obtained; the most rapid rate was 2.5 micromole/kg/day at 20 m. Assuming constant rates of methanogenesis with time, this would lead to a turnover of methane in the lake every 2 yr. The slow rate of methanogenesis suggests that the methanogens in Ace Lake may be working at well below their optimum temperature, but definitive statements regarding the presence of psychrophilic methanogens in this Antarctic lake must await further studies. (Author's abstract)
W91-12109

ASSOCIATIONS BETWEEN LAKE PHYTOPLANKTON COMMUNITY AND GROWTH FACTORS--A CANONICAL CORRELATION ANALYSIS.
Helsinki Univ. of Technology, Espoo (Finland). Lab. of Hydrology and Water Resources Engineering.
O. Varis.
Hydrobiologia HYDRB8, Vol. 210, No. 3, p 209-216, March 1991. 4 fig, 2 tab, 28 ref.

Descriptors: *Algae, *Canonical correlation analysis, *Limnology, *Nutrients, *Phytoplankton, *Statistics, Algal blooms, Biomass, Cyanophyta, Finland, Lake Kuortaneenjarvi, Light, Nitrogen, Phosphorus, Population dynamics, Primary productivity, Water temperature.

Lake Kuortaneenjarvi (Finland), a shallow (mean depth 3.7 m) lake of 16 sq km in a partially forested area, has experienced blooms of Cyanobacteria. Canonical correlation analysis was used to study the associations between the prevalent phytoplankton species and nine physical and chemical growth factors (temperature, total N, NH4, NO3, total P, PO4, N/P (total), N/P (dissolved), and irradiance) in this polyhumic lake. The analysis was made: (1) to the 10 species with the greatest mean biomass in the data over one growth season; and (2) to the 10 species providing the greatest canonical correlation with the growth factors. The species of the second group were detected using an exchange type procedure. The analysis showed strong associations within phyla; Cyanobacteria, especially, exhibited a pronounced mutual association, and they correlated significantly with N/P ratio (both total and dissolved) and positively with P. (Author's abstract)
W91-12110

EFFECTS OF SPATES ON INTERSTITIAL ASSEMBLAGES OF THE RHONE RIVER: IMPORTANCE OF SPATIAL HETEROGENEITY.
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
For primary bibliographic entry see Field 2E.
W91-12111

TEMPORAL CHANGES IN WETLAND LANDSCAPES OF A SECTION OF THE ST. LAWRENCE RIVER, CANADA.
Montreal Univ. (Quebec). Inst. Botanique.
M. Jean, and A. Bouchard.
Environmental Management EMNGDC, Vol. 15, No. 2, p 241-250, March/April 1991. 4 fig, 5 tab, 67 ref. Natural Sciences and Engineering Research Council of Canada Grant A8328.

Descriptors: *Canada, *Ecological effects, *St Lawrence River, *Succession, *Wetlands, Dredging, Land use, Marsh plants, Species composition, Species diversity, Temporal variation, Urbanization, Vegetation effects, Wildlife habitats.

Historical aerial photographs (from 1946 through 1983) were used to study and describe the nature and extent of changes in wetland vegetation of a section of the St. Lawrence River, and to evaluate the relative importance of water level, fire, and vegetational development as causal factors of these historical changes. Data were encoded and analyzed using a geographical information system, autocorrelation, and Mantel tests. Results show three temporal patterns in wetland dynamics. First, some wetland zones have been reduced by human activities (urbanization, landfilling, canal dredging). The second group consists of wetland areas that remain stable and do not change over time. They are generally protected sites artificially maintained by water level control. A third situation has occurred in the Lake Saint-Francois National Wildlife Area, where no significant wetland losses were detected, but where landscape structure has changed greatly. Modeling with Mantel tests suggests that, in the case where landscapes have changed without wetland loss, these changes are related to the suppression of burning (fires set deliberately by Indians) since the purchase of the territory by the Canadian federal government. This situation has caused rapid replacement of wet meadows by Alnus rugosa scrub and a possible decline in habitat diversity. (Author's abstract)
W91-12117

USEFULNESS OF NATURAL REGIONS FOR LAKE MANAGEMENT: ANALYSIS OF VARIATION AMONG LAKES IN NORTHWESTERN WISCONSIN, USA.
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5G.
W91-12121

EFFECT OF FETCH ON PERIPHYTON SPATIAL VARIATION.
McGill Univ., Montreal (Quebec). Dept. of Biology.
A. Cattaneo.
Hydrobiologia HYDRB8, Vol. 206, No. 1, p 1-10, October 15, 1990. 8 fig, 3 tab, 38 ref.

Descriptors: *Biomass, *Grazing, *Limnology, *Periphyton, *Spatial distribution, *Wave action, Algae, Diatoms, Ecosystems, Lake ecology, Lakes, Models, Nutrients, Population dynamics, Seasonal variation, Silica.

The marked spatial variation in periphyton could reflect differences in exposure, grazing or substratum of lakes. To determine if any of these factors was significant, the relationship between the degree of exposure to waves (measured as fetch), grazing intensity (measured as invertebrate biomass), and spatial variation in periphyton biomass in sites of similar substratum along an island in the central mesotrophic basin of Lake Memphremagog, Quebec were studied. In spring, there was a positive relationship between fetch and periphyton biomass both on stones and on artificial substrata. This effect was especially strong for: diatoms, algae between 100-1000 cu microns, planktonic forms and filamentous and long-stalked species. In spring, water renewal encouraged growth of these forms, but the effect disappeared in summer, coincident with silica depletion. Grazers, which were not important in the spatial variation observed in spring, probably contributed to the sudden decline of periphyton in the exposed sties in summer. Observations in nearby lakes indicate that these patterns may be general. (Author's abstract)
W91-12122

VARIATION IN NUTRIENT LIMITATION OF LOTIC AND LENTIC ALGAL COMMUNITIES IN A TEXAS (USA) RIVER.
Southwest Texas State Univ., San Marcos. Aquatic Station.
For primary bibliographic entry see Field 2E.
W91-12125

LITTER PROCESSING IN DIFFUSE AND CONDUIT SPRINGS.
Minnesota Univ., St. Paul. Dept. of Forest Resources.
For primary bibliographic entry see Field 2F.
W91-12127

INFLUENCE OF HUMIC SUBSTANCES ON THE AEROBIC DECOMPOSITION OF SUBMERGED LEAF LITTER.
Georgia Univ., Athens. Inst. of Ecology.
R. G. Qualls, and B. L. Haines.
Hydrobiologia HYDRB8, Vol. 206, No. 2, p 133-138, October 22, 1990. 1 fig, 1 tab, 23 ref. NSF Grant BSR-8501424.

Descriptors: *Decomposition, *Environmental chemistry, *Humic substances, *Litter, *Organic acids, Aerobic conditions, Decomposing organic matter, Fulvic acids, Humic acids, Hydrogen ion concentration, Organic matter.

The recent acidification of streams and lakes by mineral acids makes it important to distinguish between the effects of organic and mineral acidity on the decomposition of leaf litter. The effects of hydrogen ion activity and dissolved fulvic or humic acid on the decomposition of submerged leaf litter under aerobic conditions was examined by incubating leaf material in flasks containing streamwater in which the pH and the concentration of isolated fulvic acid were varied independently of one another. Decomposition of the leaf material was slower at pH 4 than at pH 5 or 7, but the concentration of fulvic acid had no effect when the pH was held constant; at pH 5, 20 mg C/L humic acid also had no effect on decomposition. High concentrations of dissolved fulvic acids may contribute to the slow decomposition of plant litter characteristic of many wetlands through their contribution to hydrogen ion activity, but no evidence for other properties of fulvic acid were found which inhibit leaf litter decomposition. (Geiger-PTT)
W91-12129

ACCUMULATION OF ARSENIC BY AQUATIC PLANTS.
Pertanian Malaysia Univ., Serdang. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W91-12153

ZOOPLANKTON ASSEMBLAGES IN THE SHALLOW TIDAL ESTUARY OF MUNDAKA (BAY OF BISCAY).
Universidad del Pais Vasco, Bilbao (Spain). Lab. de Ecologia.

For primary bibliographic entry see Field 2L.
W91-12162

EFFECT OF KINGSTON HARBOUR OUTFLOW ON THE ZOOPLANKTON POPULATIONS OF HELLSHIRE, SOUTH-EAST COAST, JAMAICA.
University of the West Indies, Kingston (Jamaica). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W91-12171

SEASONAL PHYTOPLANKTON COMPOSITION, PRODUCTIVITY AND BIOMASS IN THE NEUSE RIVER ESTUARY, NORTH CAROLINA.
North Carolina Univ., Morehead City. Inst. of Marine Sciences.
M. A. Mallin, H. W. Paerl, and J. Rudek.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No. 6, p 609-623, June 1991. 3 fig, 3 tab, 55 ref. NOAA Grant No. NA86AA-D-SG046, University of North Carolina Sea Grant Project R/MER-10, and the Albemarle-Pamlico Estuarine Study Grant No. EPA-CE 00470601.

Descriptors: *Biomass, *Estuaries, *Neuse Estuary, *North Carolina, *Phytoplankton, *Primary productivity, *Seasonal variation, Chlorophyll a, Dinoflagellates, Light intensity, Limiting nutrients, Mixing, Nitrates, Nitrogen, Rainfall.

Phytoplankton community composition, productivity and biomass characteristics of the mesohaline lower Neuse River estuary were assessed monthly from May 1988 to February 1990. An incubation method which considered water column mixing and variable light exposure was used to determine phytoplankton primary productivity. The summer productivity peaks in this shallow estuary were stimulated by increases in irradiance and temperature. However, dissolved inorganic nitrogen loading was the major factor controlling ultimate yearly production. Dynamic, unpredictable rainfall events determined magnitudes of seasonal production pulses through nitrogen loading, and helped determine phytoplankton species composition. Dinoflagellates occasionally bloomed but were otherwise present in moderate numbers; rainfall events produced large pulses of cryptomonads, and dry seasons and subsequent higher salinity led to dominance by small centric diatoms. Daily production was strongly correlated ($r=0.82$) with nitrate concentration and inversely correlated ($r=-0.73$) with salinity, while nitrate and salinity were inversely correlated ($r=-0.71$), emphasizing the importance of freshwater input as a nutrient loading source to the lower estuary. During 1989 mean daily areal phytoplankton production was 938 mg C/sq m, mean chlorophyll a was 11.8 mg/cu m, and mean phytoplankton density was 1,560 cells/mL. Estimated 1989 annual areal phytoplankton production for the lower estuary was 343 g C/sq m. (Author's abstract)
W91-12172

STATUS AND SEASONALITY IN THE PHYSICO-CHEMICAL HYDROLOGY OF A NIGERIAN RAINFOREST POND.
Cross River State Univ., Uyo (Nigeria). Dept. of Zoology and Fisheries.
R. P. King, and N. A. Nkanta.
Japanese Journal of Limnology RIZAAU, Vol. 52, No. 1, p 1-12 , January 1991. 4 fig, 1 tab, 27 ref.

Descriptors: *Limnology, *Mfangmfang Pond, *Nigeria, *Physicochemical properties, *Rain forests, *Water chemistry, Dissolved oxygen, Hydrogen ion concentration, Hydrologic properties, Nitrates, Phosphates, Precipitation, Suspended solids, Temperature, Transparency, Water level, Water quality.

Monthly and seasonal regimes in the physicochemical status of Mfangmfang pond, Uyo, Nigeria, were studied. Meteorological conditions depicted a short dry (November-February) and a prolonged wet (March-October) season. From the trends in hydrological variables, it was inferred that the integrated impact of precipitation, changes in pond level, input of surface runoff and municipal effluents played an over-riding role in determining the absolute levels and temporal patterns in the water quality attributes. The physicochemical parameters were assigned to three categories according to the types of seasonal and anthropogenic influences: (1) dry season maximum (transparency, dissolved oxygen, free CO_2, nitrate nitrogen), resulting from low precipitation with concomitant reductions in input of surface runoff/municipal effluents and pond level; (2) wet season maximum (suspended solids, conductivity, phosphate phosphorus), resulting from increased precipitation with concomitant increases in the input of surface runoff/municipal effluents and pond level; and (3) no substantial seasonality (surface temperature, pH, total alkalinity) due to absence of significant influences of the wet dry season cycle and surface runoff/municipal effluents. (Author's abstract)
W91-12175

DYNAMICS OF PARTICULATE MATTER NEAR THE MOUTH OF INFLUX RIVER IN TAKAHAMAIRI BAY OF LAKE KASUMIGAURA, WITH SPECIAL REFERENCE TO NITROGEN AND PHOSPHORUS.
National Inst. for Environmental Studies, Tsukuba (Japan).
T. Fukishima, M. Aizaki, and S. Ebise.
Japanese Journal of Limnology RIZAAU, Vol. 52, No. 1, p 13-26, January 1991. 12 fig, 4 tab, 21 ref.

Descriptors: *Hydrodynamics, *Lake Kasumigaura, *Limnology, *Nitrogen, *Nutrient transport, *Particulate matter, *Phosphorus, *Takahamairi Bay, Chlorophyll a, Estuaries, Japan, Model studies, Nutrients, Organic carbon, Storm runoff, Water quality.

To understand the dynamic changes in water quality near the mouth of influx rivers (lake estuaries), two kinds of surveys were performed in Takahamairi Bay of Lake Kasumigaura. The first survey was the regular water sampling mainly to measure carbon, nitrogen, phosphorus, and metal compositions of particulate matter, and then to analyze the mutual relationships. A three component model (comprising of soil particles, allochthonous organic matter, and autochthonous matter) on the basis of Ti and chlorophyll a compositions, was successfully applied for the explanation of the longitudinal distribution of phosphorus content, which had very different characteristics from those of organic carbon, organic nitrogen. To some extent, these variations in composition could be accounted for by the meteorological and hydraulic conditions. The second survey studied the dynamics of nitrogen, phosphorus, and other water qualities as described for the direct runoff period due to a rainfall of 23 mm. Through budgetary calculation, it was determined that 40% of the total load for a stormy period and 55% on a dry weather day were trapped in the lake estuary. These surveys indicate that the behavior of particulate matter in a lake estuary greatly affects the fate of influent nitrogen and phosphorus in the entire lake. (Author's abstract)
W91-12176

DYNAMIC SEDIMENTATION PROCESSES IN A GLACIER-FED LAKE, PEYTO LAKE, ALBERTA, CANADA.
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
For primary bibliographic entry see Field 2J.
W91-12177

BUOYANT DENSITY OF CHROMATIUM SP.: ITS EFFECT ON THE BLOOMING AT AN UPPER BOUNDARY OF THE H2S LAYER IN LAKE KAIIKE.
Nagasaki Univ. (Japan). Dept. of Oceanography.
M. Matsuyama.
Japanese Journal of Limnology RIZAAU, Vol. 52, No. 1, p 57-63, January 1991. 5 fig, 20 ref.

Descriptors: *Algae blooms, *Chromatium, *Hydrogen sulfide, *Lake Kaiike, *Limnology, Algal growth, Bacteria, Ecosystems, Japan, Population dynamics, Water quality.

Two kinds of motile large-celled bacteria, Chromatium sp. and Macromonas sp., form steady-state dense populations at the upper boundary of the H2S layer in Lake Kaiike, Japan. The buoyant density of Chromatium sp. estimated to be 1.26 gm/cu m was considerably higher than that of the habitat. Cells of Chromatium sp. killed with formalin settled at a rate of about 0.8 cm/hr. Living cells moved rapidly toward an upper light source when the number was $< 1{,}000{,}000$ cells/mL. However, when the number reached a level of 2,500,000 cells/mL, further upward movement was not observed. Number of Chromatium sp. at the upper boundary of the H2S layer, 100,000 to 1,000,000 cells/mL, was considered to approximate the maximum level attainable at the boundary; above this number the bacterium seems unable to find swimming space sufficient to respond to tactic stimulus due to the excess crowding. (Author's abstract)
W91-12178

TRANSPORT AND RETENTION OF PARTICULATE ORGANIC MATTER IN TWO LOW-GRADIENT HEADWATER STREAMS.
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
For primary bibliographic entry see Field 2J.
W91-12179

EFFECTS OF DISTURBANCE ON STREAM MOSS AND INVERTEBRATE COMMUNITY STRUCTURE.
Umea Univ. (Sweden). Dept. of Animal Ecology.
For primary bibliographic entry see Field 2E.
W91-12181

RAPID GROWTH OF SNAG-DWELLING CHIRONOMIDS IN A BLACKWATER RIVER: THE INFLUENCE OF TEMPERATURE AND DISCHARGE.
Alabama Univ. in Birmingham. Dept. of Biology.
For primary bibliographic entry see Field 2E.
W91-12182

SURVIVAL OF INTRODUCED SMALLMOUTH BASS IN LOW-PH LAKES.
Trent Univ., Peterborough (Ontario). Watershed Ecosystems Program.
For primary bibliographic entry see Field 5C.
W91-12184

DISTRIBUTION OF BACTERIA IN THE SEDIMENT OF AN OXBOW TROPICAL LAKE (LAGOA DO INFERNAO, SP, BRAZIL).
Universidade Federal de Sao Carlos (Brazil). Dept. of Biology.
E. A. C. Freitas, and M. J. L. Godinho-Orlandi.
Hydrobiologia HYDRB8, Vol. 211, No. 1, p 33-41, March 15, 1991. 6 fig, 3 tab, 28 ref.

Descriptors: *Aquatic bacteria, *Brazil, *Lake sediments, *Limnology, *Oxbow lakes, *Tropical regions, Biomass, Ecology, Mogi-Guacu River, Oxidation-reduction potential, Seasonal variation, Temporal distribution.

Bacterial densities of the order of 1 to 10 million per gram dry weight have been reported from the sediments of various lakes. The temporal distribution of bacteria on the surface sediment of the oxbow lake Lagoa do Infernao, which borders the Mogi-Guacu River, Brazil, was studied over a period of 1 yr using different techniques of bacterial counting. Several bacterial groups were differentiated, including total bacteria and filamentous, heterotrophic, amylolytic, and lipolytic bacteria. The best-defined temporal distribution pattern was obtained by total-acridine orange counts, with a variation of 1.26 times ten to the 10th power and 8.58 times ten to the 10th power bacteria per gram dry weight during the dry and wet seasons, respectively. The electrode potential (Eh) of the surface sediment ranged from -148 mV during the rainy season to +371 mV during the dry season. The variations detected on the surface sediment suggest a greater allochthonous contribution of material

and bacteria resulting in high decomposing activity during the rainy season. (Author's abstract)
W91-12185

BACTERIAL SECONDARY PRODUCTION AND ITS RELATION WITH PRIMARY PRODUCTION IN THE EMBALSE DEL RIO III RESERVOIR, ARGENTINA.
Universidad Nacional de La Plata (Argentina). Inst. de Limnologia.
A. A. Mariazzi, M. A. Di Siervi, and J. L. Donadelli.
Hydrobiologia HYDRB8, Vol. 211, No. 1, p 57-64, March 15, 1991. 4 fig, 3 tab, 29 ref.

Descriptors: *Aquatic bacteria, *Argentina, *Limnology, *Primary productivity, *Reservoirs, *Secondary productivity, Algae, Carbon radioisotopes, Chlorophyll, Embalse del Rio III Reservoir, Eutrophic lakes, Isotope studies, Organic matter, Photosynthesis, Seasonal variation, Water temperature.

Bacteria can use organic matter efficiently, turning low organic carbon concentrations into a more concentrated form, available to higher trophic levels. During an annual period the bacterial biomass (epifluorescence) and secondary production (methyl-3H-thymidine incorporation), as well as biomass (chlorophyll) and algal primary production (incorporation of NaH14CO3) were studied in the Embalse del Rio III Reservoir, Argentina. The relations between these variables and their responses to seasonal changes in water temperature were analyzed. A close relationship in seasonal patterns of algal primary production and bacterial secondary production was observed, with the estimated rates of bacterial production similar to that obtained by others in eutrophic lakes. Bacterial production was 17-46% of the primary production. Thus, at 60% assimilation efficiency, the bacterioplankton would consume 28-77% of the total fixed carbon. Seasonal trends in algal primary production and bacterial secondary production were affected mainly by temperature. (Author's abstract)
W91-12186

COLONIZATION OF A HEADWATER STREAM DURING THREE YEARS OF SEASONAL INSECTICIDAL APPLICATIONS.
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 5C.
W91-12187

DECOMPOSITION OF WATER HYACINTH DETRITUS IN EUTROPHIC LAKE WATER.
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
K. R. Reddy, and W. F. DeBusk.
Hydrobiologia HYDRB8, Vol. 211, No. 2, p 101-109, March 22, 1991. 5 fig, 4 tab, 23 ref.

Descriptors: *Decomposition, *Detritus, *Eutrophic lakes, *Florida, *Limnology, *Water hyacinth, Carbon, Correlation analysis, Lake Apopka, Lake sediments, Nitrogen, Phosphorus, Sediment-water interfaces, Weeds.

Detritus from water hyacinth (Eichhornia crassipes (Mart.) Solms) is generated as a result of such factors as aging of plants, overcrowding, pest damage, herbicide application for control of plants, and frost damage during winter. A study was conducted to determine the seasonal production of detritus by water hyacinth cultured in Lake Apopka (Florida) water, and the decomposition of detritus in situ under laboratory conditions. Annual averages of C, N, and P deposited through detritus production at the sediment-water interface were 2870, 176, and 19 kg/ha per yr, respectively. Decomposition rates were faster in the root zone of hyacinth mats than at the sediment-water interface. Approximately 92% of the detrital C deposited in at the sediment-water interface was decomposed in 1 yr, whereas only 11% of the detrital organic N was mineralized. Detrital tissue gained P during decomposition, suggesting P limitation of the system. Dry-weight loss of detrital tissue was significantly correlated with the mass of C lost (r-squared = 0.947 (highly significant)), C/N ratio (r-squared = 0.644 (highly significant)), and C/P ratio (r-squared = 0.428 (highly significant)). (Author's abstract)
W91-12188

SURBER AND KICK SAMPLING: A COMPARISON FOR THE ASSESSMENT OF MACROINVERTEBRATE COMMUNITY STRUCTURE IN STREAMS OF SOUTH-WESTERN AUSTRALIA.
Western Australia Univ., Nedlands. Dept. of Zoology.
For primary bibliographic entry see Field 7B.
W91-12189

EUCALYPT LEAF DECOMPOSITION IN AN INTERMITTENT STREAM IN SOUTH-EASTERN AUSTRALIA.
Monash Univ., Clayton (Australia). Dept. of Botany.
For primary bibliographic entry see Field 2E.
W91-12190

COMPARATIVE ASPECTS OF ADAPTIVE RADIATION AND SPECIATION IN LAKE BAIKAL AND THE GREAT RIFT LAKES OF AFRICA.
Lancaster Univ. (England). Dept. of Environmental Sciences.
G. Fryer.
Hydrobiologia HYDRB8, Vol. 211, No. 2, p 137-146, March 22, 1991. 20 ref.

Descriptors: *Biogeography, *Lake Baikal, *Lake Nyasa, *Lake Tanganyika, *Limnology, *Rift lakes, *Speciation, Africa, Allopatry, Invertebrates, Physiography, Sympatry, Taxonomy.

Lakes Baikal, Tanganyika, and Malawi have similar origins, are physiographically similar, and are of similar size. The hydrologic regime in Lake Baikal is very different from that prevailing in the African lakes. Apart from being much cooler it differs fundamentally in being oxygenated to all depths, whereas the two great African rift lakes possess only a relatively thin oxygenated surface layer and have vast oxygenless, and therefore azoic, abyssal regions. Nevertheless, like Baikal, they have rich endemic faunas. Comparisons among the lakes are illuminating. Some species flocks, such as those of amphipods, sponges, and turbellarians of Baikal and the atyid prawns and potamid crabs of Tanganyika, have no counterparts in other lakes. Other groups, such as the prosobranch gastropods, ostracods, and harpacticoid copepods of Baikal and Tanganyika, and all the fishes of all three, involve representatives of the same major group, though often of different families or even higher taxonomic categories. That allopatric speciation has been involved is universally acknowledged, but the problems posed by species multiplication in deep water in Lake Baikal have led to suggestions that sympatric speciation could have played a part. Notwithstanding the difficulties, it is suggested that the process can be explained without invoking the assistance of the sympatric model. (Author's abstract)
W91-12191

TRANSPORT OF COARSE PARTICULATE ORGANIC MATTER IN AN IDAHO RIVER, USA.
Idaho State Univ., Pocatello. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2J.
W91-12192

ZOOPLANKTON INDUCED DECREASE IN INORGANIC PHOSPHORUS UPTAKE BY PLANKTON IN AN OLIGOTROPHIC LAKE.
Montana State Univ., Bozeman. Dept. of Biology.
W. K. Dodds, B. K. Ellis, and J. C. Priscu.
Hydrobiologia HYDRB8, Vol. 211, No. 3, p 253-259, March 29, 1991. 3 fig, 1 tab, 20 ref.

Descriptors: *Cycling nutrients, *Limnology, *Montana, *Oligotrophic lakes, *Phosphorus, *Plankton, *Zooplankton, Algae, Daphnia, Flathead Lake, Isotope studies, Phosphorus radioisotopes.

Laboratory experiments have shown that phosphorus regenerated by zooplankton can be used by P-deficient algae. Experiments conducted on samples collected from a large oligotrophic lake (Flathead Lake, Montana; 430 sq km, mean depth 53 m) revealed the following: (1) excretion rates of PO4(3-) by single Daphnia thorata were below detection (5 pmol/animal/min) in 20 ml of oligotrophic water over a period of 10 min; (2) experimental addition of D. thorata to 20-ml aliquots of lake water decreased community-wide microbial uptake of PO4(3-) on two occasions (as measured by 32PO4(3-) incorporation); and (3) the presence of D. thorata increased uptake by organisms smaller than 1 micrometer and decreased uptake by large phytoplankton. The specific mechanism for these responses remains unclear, but the results imply that when phytoplankton larger than 1 micrometer encounter centimeter-scale patches of water occupied recently by Daphnia they may experience decreased PO4(3-) availability rather than elevated concentrations of PO4(3-) caused by excretion. 32P uptake experiments using natural plankton assemblages can be influenced by the presence or absence of large zooplankton; neither grazing, turbulence, nor PO4(3-) excretion can account for this influence. (Author's abstract)
W91-12194

LIFE HISTORY AND DISTRIBUTION OF MAYFLIES (EPHEMEROPTERA) IN SOME ACID STREAMS IN SOUTH CENTRAL ONTARIO, CANADA.
Toronto Univ. (Ontario). Dept. of Zoology.
D. J. Giberson, and R. J. Mackay.
Canadian Journal of Zoology CJZOAG, Vol. 69, No. 4, p 899-910, April 1991. 11 fig, 2 tab, 45 ref. Natural Sciences and Engineering Research Council of Canada operating grant A9881.

Descriptors: *Acid rain effects, *Acid streams, *Canada, *Life history studies, *Mayflies, *Stream biota, Aquatic insects, Hydrogen ion concentration, Population density, Snowmelt, Streams.

Life histories and distribution of mayflies (Insecta: Ephemeroptera) were investigated in 11 streams in south central Ontario that ranged from highly acidic to circumneutral. At least 29 mayfly species were recorded from the streams, with 16 common enough for life history analysis. Mayfly distribution and diversity were correlated with pH regime and stream size. No mayflies were found in the smallest, most acid stream, and numbers of mayfly species and their relative abundances generally increased with both increasing stream size and stream pH. Incorporation of life cycle information with distributional data enabled the determination of the precise stream-water pH range encountered by different mayfly life stages in the study streams. Generally, during a period of greatest acid stress in the streams (pH depression associated with spring snowmelt) the mayflies were present in large or dormant stages, which are believed to be more tolerant of lowered pH. (Author's abstract)
W91-12259

METAL CONCENTRATIONS IN CRAYFISH TISSUES IN RELATION TO LAKE PH AND METAL CONCENTRATIONS IN WATER AND SEDIMENTS.
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W91-12260

PHYTOPLANKTONIC SOURCES OF VOLATILE ALDEHYDES IN THE RIVER RHONE ESTUARY.
Laboratoire de Physique et Chimie Marines, Villefranche-sur-Mer (France).
E. Jalliffier-Merlon, J. C. Marty, V. Denant, and A. Saliot.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No. 5, p 463-482, May 1991. 15 fig, 4 tab, 47 ref.

Descriptors: *Algae, *Bioindicators, *Degradation, *Hydrocarbons, *Phytoplankton, *Rhone Estuary, *Volatile organic compounds, *Water

chemistry, Chlorophyta, Diatoms, Dinoflagellates, Liquid chromatography, Seasonal variation.

A study of volatile aldehydes in the Rhone delta was undertaken in order to understand degradation processes giving rise to these compounds. Pigments, analyzed by high-performance liquid chromatography, were used to characterize phytoplanktonic populations responsible for aldehyde inputs to the medium. Concentrations of n-C6 to n-C13 aldehydes ranged from 23 nanograms/L to 295 nanograms/L for surface waters. Both the concentration and the composition of aldehydes were seasonally dependent, reflecting changes in the phytoplanktonic populations. The major components during all cruises were hexanal to decanal, and were associated with diatoms and green algae. Undecanal was the characteristic biomarker of dinoflagellates, nonanal and tridecanal of cyanophytes. The occurrence of high concentrations in several specific situations (frontal zone) indicated other sources of aldehyde production. Aldehydes are proposed as powerful biomarkers in studies of small temporal scale events, particularly in frontal zones. (Author's abstract)
W91-12267

CHEMICAL LIMNOLOGY OF A HYPERTROPHIC GRAVEL-PIT LAKE.
Centro de Investigaciones del Agua, Madrid (Spain).
M. Alvarez Cobelas, A. Rubio, and J. L. Velasco.
Annales de Limnologie ANLIB3, Vol. 26, No. 2/3, p 97-108, 1990. 10 fig, 4 tab, 35 ref.

Descriptors: *Hypertrophy, *Limnology, *Water chemistry, Alkalinity, Anoxia, Dissolved oxygen, El Porcal Lake, Gravel-pit lakes, Madrid, Nitrification, Nutrients, Spain, Temporal distribution.

El Porcal Lake (close to Madrid, Spain) is an alkaline, slightly saline, hypertrophic, gravel-pit lake without surface inflow or outflow. Anoxia is a common feature below the 2-m level from May to September. Dissolved oxygen oversaturation and pH above 9.00 occurred frequently in surface waters throughout a study period of one year. Total alkalinity ranged from 2.5 to 3.5 meq/L, bicarbonate being the main inorganic carbon fraction. Inorganic carbon is a key parameter in the chemistry of the lake, as indicated by statistical correlations. Nitrate and nitrite values were very high, probably as a result of high nitrification rates. Ammonia levels were lower than those of nitrite and nitrate. Soluble Reactive Phosphorus ranged over three orders of magnitude, sometimes occurring below detection limits. No plankton collapses were observed, but frequent oscillations in the chemical parameters were common throughout the year. Groundwater seepage is thought to be an important source of nutrients. Most of the chemical features showed time lags of a week in autocorrelation functions, suggesting an unknown control mechanism for the temporal dynamics of the chemical limnology of El Porcal Lake. (Author's abstract)
W91-12269

DESMIDS AS INDICATORS OF WATER QUALITY IN THE MARRAKECH REGION (MOROCCO) (DESMIDIEES EN TANT QU'INDICATEURS DE LA QUALITE DES EAUX DANS LA REGION DE MARRAKECH (MAROC)).
Cadi Ayyad Univ., Marrakech (Morocco). Dept. de Biologie.
K. Mouhri, J. Darley, R. Le Cohu, and J. Loudiki.
Annales de Limnologie ANLIB3, Vol. 26, No. 2/3, p 109-118, 1990. 8 fig, 32 ref. English summary.

Descriptors: *Bioindicators, *Desmids, *Limnology, *Monitoring, *Morocco, *Water quality, Algae, Dayas, Marrakech, Reservoirs.

Thirty-seven diverse sites (reservoirs and dayas) within the Marrakech Region, Morocco, were investigated semimonthly or monthly over the period of a year. Two factorial correspondence analyses demonstrated the similar typologies--one based only on the environmental factors, and an other based on biotic parameters (133 Desmid taxons). It was concluded that Desmids are good biological indicators for evaluating water quality in Southern Morocco. (Author's abstract)
W91-12270

BIOLOGICAL AND ECOLOGICAL STUDY OF THE AQUATIC OLIGOCHAETES OF THE RIVER TAMBRE AND ITS ENVIRONMENT (GALICIA, SPAIN) (ETUDE BIOLOGIQUE ET ECOLOGIQUE DES OLIGOCHETES AQUATIQUES DE LA RIVIERE TAMBRE ET DE SES MILIEUX ASSOCIES (GALICE, ESPAGNE)).
Dpto. Bioloxia Animal, Univ. A Cornua, Campus da Zapateira s/n., 15071 A Coruna, Spain.
For primary bibliographic entry see Field 2E.
W91-12272

BEAVER POPULATION FLUCTUATIONS AND TROPOSPHERIC METHANE EMISSIONS IN BOREAL WETLANDS.
Washington Univ., Seattle. Center for Streamside Studies.
R. J. Naiman, T. Manning, and C. A. Johnston.
Biogeochemistry BIOGEP, Vol. 12, No. 1, p 1-15, January 1991. 2 fig, 4 tab, 64 ref.

Descriptors: *Aquatic animals, *Atmospheric chemistry, *Beavers, *Methane, *Methanogenesis, *Wetlands, Air pollution, Beaver ponds, Global warming, Methane emissions, Methane flux, Minnesota, Ponds, Population dynamics, Seasonal variation.

Measurements of net methane flux were made during the 1988 ice-free season (May-October) at a beaver meadow complex in northern Minnesota. The site included an upland boreal forest, a sedge meadow, submerged aquatic plants, and the open water of a beaver pond. Annual fluxes were 8-11 g C/sq m in the permanently wetted zones and 0.2-0.4 g C/sq m at the occasionally inundated meadow and forest sites. Daily methane flux was significantly correlated with temperature in the submergent zone. In the deep zone, both temperature and redox potential significantly influenced the daily methane evasion rates. These data, when coupled with long-term (46 yr) data on beaver (Castor canadensis) population size and habitat alteration, suggest that about 1% of the recent rise in atmospheric methane may be attributable to pond creation by beaver in North America. (Author's abstract)
W91-12274

CHEMICAL CHARACTER AND ORIGIN OF ORGANIC ACIDS IN STREAMS AND SEEPAGE LAKES OF CENTRAL MAINE.
Illinois Univ., Urbana. Dept. of Forestry.
M. B. David, and G. F. Vance.
Biogeochemistry BIOGEP, Vol. 12, No. 1, p 17-41, January 1991. 12 fig, 4 tab, 52 ref. EPA Agreement CR813572.

Descriptors: *Acidification, *Acidity, *Dissolved organic carbon, *Environmental chemistry, *Lakes, *Limnology, *Maine, *Organic acids, *Seepage lakes, *Stream chemistry, *Water chemistry, Carboxylic acids, Hydrogen ion concentration, Hydrophilic compounds, Hydrophobic compounds, Seepage, Water quality.

Organic acids and inorganic chemistry were examined in seventeen seepage lakes, seven streams, and one seep in central Maine. Lakes and streams sampled were dilute (average conductivity of 20.3 microS/cm) with a wide range of dissolved organic carbon (DOC) (125-2593 micromol C/L). All lakes and streams were dominated by hydrophobic and hydrophilic acids (60-92% of DOC). Hydrophobic to hydrophilic acid ratios were 1.2-1.3 for lakes and streams with low DOC, and 1.9-2.4 for those with high DOC, regardless of pH and acid neutralizing capacities. Organic acids were found to be dominated by a strong carboxylic character. Titration data of isolated DOC allowed accurate prediction of organic anions, which were strongly pH dependent. Exchange acidity averaged 11.3, 13.6, and 8.7 microeq/mg C for lake hydrophobic acids, lake hydrophilic acids, and stream hydrophobic acids, respectively. Overall evidence suggested that DOC and organic acid characteristics were related to their carboxylic functional group content and that the nature of these constituents was similar despite the source of origin (upland soils, wetlands, or Sphagnum deposits). Also, contact of soil leachates with B horizons seemed to be a controlling factor in DOC quantity and quality in the lakes and streams studied. (Author's abstract)
W91-12275

SEASONAL VARIABILITY IN THE MERCURY SPECIATION OF ONONDAGA LAKE (NEW YORK).
Brooks Rand Ltd., Seattle, WA.
For primary bibliographic entry see Field 5B.
W91-12295

COMPARISON OF FOUR METHODS FOR MEASURING CHITINASE ACTIVITY AND THE APPLICATION OF THE 4-MUF ASSAY IN AQUATIC ENVIRONMENTS.
University of West Florida, Pensacola. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W91-12307

MICRO-ENVIRONMENTAL CHARACTERISTICS OF FILAMENTOUS ALGAL COMMUNITIES IN FLOWING FRESHWATERS.
Montana State Univ., Bozeman. Dept. of Biology.
For primary bibliographic entry see Field 2E.
W91-12308

POPULATION DYNAMICS AND PRODUCTION OF DAPHNIA HYALINA AND BOSMINA LONGIROSTRIS IN A SHALLOW, EUTROPHIC RESERVOIR.
Essex Univ., Colchester (England). Dept. of Biology.
C. F. Mason, and M. M. Abdul-Hussein.
Freshwater Biology FWBLAB, Vol. 25, No. 2, p 243-260, April 1991. 12 fig, 4 tab, 37 ref, 2 append.

Descriptors: *Bosmina, *Daphnia, *Eutrophic lakes, *Limnology, *Population dynamics, Algae, Biomass, Ecosystems, England, Phytoplankton, Seasonal variation, Water temperature, Zooplankton.

The population densities, dynamics and production of Daphnia hyalina and Bosmina longirostris were studied over a 2-year period in a shallow eutrophic reservoir in eastern England. The diet of the two species was assessed and their ecology was compared in relation to environmental factors. Daphnia hyalina was characterized by small overall body size, probably due to heavy size-selective predation by fish. The first generation produced from the over-wintering population appeared in April and the population peaked in late spring and early summer. Adult survival was poor. Peak egg production varied between years, while mean brood size fell in summer probably due to food limitation during the cyanobacterial bloom. At this time selection for individual algal species was high and many guts were empty. Reproductive ratios were inversely related to population density. Bosmina longirostris exhibited a similar annual cycle. Patterns of production were very different in the 2 years in D. hyalina. In 1981 production was high from August to early October, but in 1982 the peak was in spring. Annual production was 32.4 g C/sq m in 1981 and 13.3 g C/sq m in 1982. In 1981 B. longirostris production peaked in spring and late summer; in 1982 there was a high production in summer only. Annual production was 3.2 g C/sq m in 19811 and 2.2 g C/sq m in 1982. The number of adult D. hyalina was highly correlated with water temperature and total phytoplankton biomass, but these were negatively correlated with the number of eggs, mean brood size and instantaneous birth rate. In contrast, clutch size of B. longirostris was positively correlated with water temperature while birth rate was positively correlated with both temperature and phytoplankton biomass. The biomass of both species was positively related to total phytoplankton biomass, but neither relationship ex-

plained much of the variation in zooplankton biomass. (Author's abstract)
W91-12309

ENVIRONMENTAL FACTORS INFLUENCING CHLOROPHYLL V. NUTRIENT RELATIONSHIPS IN LAKES.
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Freshwater Biology FWBLAB, Vol. 25, No. 2, p 279-295, April 1991. 11 fig, 2 tab, 66 ref.

Descriptors: *Algae, *Chlorophyll, *Limnology, *Model studies, *Nutrients, *Phosphorus, Alberta, Biomass, Ecosystems, Eutrophic lakes, Iowa, Lake Delavan, Light effects, Limiting nutrients, Nitrogen, Photosynthesis, Water circulation, Wisconsin.

A model relating log chlorophyll a concentration to log epilimnetic total phosphorus (TP) concentration was re-examined based on: (1) comparative and temporal studies of four stratifying Wisconsin and other highly eutrophic temperate lakes; and (2) comparative summer lake surveys from Iowa and Alberta. Although P-limited, deeper lakes with long hydraulic residence times and low external and internal nutrient loading in summer had summer chlorophyll a yields below model predictions based on spring and summer epilimnetic TP concentrations. For lakes with summer epilimnetic TP between 30 and 80 mg/cu m, chlorophyll a concentrations exceeded model predictions based on summer TP. This relationship held even for Lake Delavan, Wisconsin, where the ratio of available N to P was unfavorably low during spring turnover, and where the trans-thermocline N:P flux ratio was sub-optimal for algal needs in early summer. With increasing summer TP concentrations and/or increasing epilimnetic circulation depth (> 5 m), chlorophyll a concentrations fell below model predictions--independent of the potential for N-limitation. This plateauing in chlorophyll a response occurred at lower epilimnetic TP content (c. 400 mg/sq m) in lakes with elevated non-algal light extinction coefficients. Using Talling's algorithm for the 'column compensation point' (algal photosynthesis = algal respiration over diel cycle), light limitation best explains this fall-off in chlorophyll a yield. (Author's abstract)
W91-12311

LONGITUDINAL VARIATION IN RECOLONIZATION RATES OF MACROINVERTEBRATES ALONG AN UPLAND RIVER IN SOUTHEASTERN AUSTRALIA.
Museum of Victoria, Abbotsford (Australia). Centre for Stream Ecology.
For primary bibliographic entry see Field 2E.
W91-12312

SUSPENDED CLAY REDUCES DAPHNIA FEEDING RATE: BEHAVIORAL MECHANISMS.
Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.
K. L. Kirk.
Freshwater Biology FWBLAB, Vol. 25, No. 2, p 357-365, April 1991. 3 fig, 2 tab, 32 ref. NSF Grant BSR-8415024.

Descriptors: *Clays, *Daphnia, *Feeding rates, *Limnology, *Particle size, *Suspended particles, Algae, Animal behavior, Population dynamics, Suspended sediments.

Suspended sediments often reduce cladoceran abundance in the field, and reduce the algal feeding rates of cladocerans in the laboratory. Feeding experiments using radio-labeled Cyptomonas cells showed that 50-200 mg/L coarse suspended clay (particle size < 2 microm) reduced the algal ingestion rate of Daphnia ambigua by 29-87%, but fine suspended clay (< 1 microm) had no effect. Suspended clay decreased feeding rate by 60-70% at low algal concentrations (</= 5,000 cells/mL), but by only 27% at high algal concentrations (20,000 cells/mL). Thus, the inhibitory effects of suspended clay are greater at low algal concentrations. The sudden addition (or removal) of suspended clay caused immediate reductions (or increases) in algal ingestion rate. Observations of the feeding behavior of tethered D. pulex showed that the frequency of post-abdominal rejections greatly increased in the presence of suspended clay. The rejected boluses contained both algae and clay. Thoracic feeding appendage beat frequency decreased in the presence of suspended clay, decreasing the volume of water searched for food particles. These behavioral responses indicate that clay reduces cladoceran feeding rate by mechanically interfering with both the collection and ingestion of algal cells. Both inhibitory effects are caused because cladocerans collect and ingest suspended clay particles. The behavioral mechanisms by which cladocerans regulate their feeding rate in very high concentrations of algal cells (rejection of excess food and reduction in thoracic limb pumping movements) are the same mechanisms responsible for the inhibition of algal ingestion rate in the presence of high concentrations of suspended clay particles. (Author's abstract)
W91-12313

CHANGES IN STRUCTURE AND COMPOSITION OF AN ASSEMBLAGE OF HYDROPORUS SPECIES (COLEOPTERA: DYTISCIDAE) ALONG A PH GRADIENT.
Illinois State Univ., Normal. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2E.
W91-12314

EMERALD LAKE WATERSHED STUDY: INTRODUCTION AND SITE DESCRIPTION.
California State Air Resources Board, Sacramento. Research Div.
For primary bibliographic entry see Field 5B.
W91-12329

FUNDAMENTAL ASSUMPTIONS FOR THE OPERATION OF AQUATIC ECOSYSTEMS (IN RUSSIAN).
Akademiya Nauk SSSR, Leningrad. Zoologicheskii Inst.
A. F. Alimov.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 26, No. 6, p 3-12, 1990. 2 fig, 31 ref. English summary.

Descriptors: *Ecology, *Ecosystems, *Energy, *Fluctuations, *Limnology, Aquatic environment, Aquatic productivity, Energy transfer, Hydrobiology, Productivity, Thermodynamics.

The basic theoretical points on how aquatic ecosystems function, are examined. Ecosystem functions involve the dynamic interaction of energy, substance, and information fluxes which ensure their stability under particular conditions. The stability of an ecosystem is relatively constant under the average conditions (for vegetation season or a year) of structural and functional characteristics over sufficiently long spans of time. Ecosystem functions were considered, theoretically in terms of biological productivity, production hydrobiology, theory of information and thermodynamics. (Author's abstract)
W91-12372

TRANSFORMATION BY BACTERIAL COMMUNITIES OF ORGANIC MATTER SECRETED BY LIVING PHYTOPLANKTON (IN RUSSIAN).
Moscow State Univ. (USSR).
A. P. Sadchikov, and A. S. Kulikov.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 26, No. 6, p 13-16, 1990. 4 fig, 3 ref. English summary.

Descriptors: *Aquatic plants, *Aquatic productivity, *Eutrophic lakes, *Limnology, *Mesotrophic lakes, *Organic matter, *Phytoplankton, Bacteria, Cycling nutrients, Organic compounds, Physiological ecology, Productivity, Respiration.

Phytoplankton in mesotrophic and eutrophic reservoirs excreted 0.8-2.2% of its production into the water during their lifetime. Bacteria utilized 22-68% of the alga-excreted dissolved organic substances during one whole season; a little more than 60% of the bacteria-consumed dissolved organic substances were used for respiration. Aggregated bacteria had a higher physiological activity than single bacteria. Specific consumption of dissolved organic substances by aggregated bacteria, during a season, was 2-7 times greater than that of single bacteria. Maximum levels of specific physiological activity of aggregated bacteria were 14 attogm/cell/hr. Maximum levels of specific physiological activity of single bacteria were 2.5 attogm/cell/hr. (Author's abstract)
W91-12373

PHYTOPLANKTON AND CHEMICAL COMPOSITION OF THE WATERS OF LAKE JACK LONDON (MAGADAN PROVINCE) (IN RUSSIAN).
Akademiya Nauk SSSR, Magadan. Inst. Biologicheskikh Problem Severa.
G. V. Kuzmin, G. A. Agapova, and N. G. Susekova.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 26, No. 6, p 21-27, 1990. 3 fig, 2 tab, 17 ref. English summary.

Descriptors: *Algae, *Algal growth, *Jack London Lake, *Lake ecology, *Limnology, *Nutrients, *Phytoplankton, *Water temperature, Aquatic plants, Cycling nutrients, Ecosystems, Flagellates, Lakes, USSR, Vertical distribution.

The relatively low water temperature and small nutrient content in Jack London Lake can be factors which control phytoplankton development in the lake. Multicellular character and the presence of a great number of flagellate forms are basic adaptations of the planktonic algae to specific conditions within the lake. The vertical distribution of phytoplankton is characterized by mosaicism. The highest values of biomass are observed during ice thawing and in autumn. (Author's abstract)
W91-12374

VARIATION OF PHYTOPLANKTON GROWTH CHARACTERISTICS UNDER THE INFLUENCE OF LIGHT AND TEMPERATURE (IN RUSSIAN).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. N. Kozetskaya.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 26, No. 6, p 42-49, 1990. 5 fig, 3 tab, 18 ref. English summary.

Descriptors: *Algal growth, *Chlorophyta, *Light effects, *Limnology, *Phytoplankton, *Temperature effects, Algae, Aquatic populations, Ecosystems, Growth rates, Light intensity, Physiological ecology, Temperature.

The exposure of natural populations of planktonic algae under varying conditions of light and temperature, showed an inadequate response of both the community as a whole, and the individual algal species constituting the phytoplanktonic community. Light and temperature were determined to be of major ecological significance. (Author's abstract)
W91-12377

FORMATION OF THE HYDROCHEMICAL REGIME IN SMALL RESERVOIRS OF THE STEPPES IN THE DNEPR REGION (IN RUSSIAN).
For primary bibliographic entry see Field 5C.
W91-12379

BACTERIA AS A SOURCE OF PHOSPHORUS FOR ZOOPLANKTON.
Norsk Inst. for Vannforskning, Oslo.
B. O. Hessen, and T. Andersen.
Hydrobiologia HYDRB8, Vol. 206, No. 3, p 217-223, October 29, 1990. 6 fig, 1 tab, 19 ref.

Descriptors: *Bacteria, *Ecosystems, *Limnology, *Phosphorus, *Zooplankton, Aquatic productivity, Bacterial productivity, Biomass, Copepods, Daphnia, Extracellular metabolism, Foods, Nutrients, Phosphorus radioisotopes, Waterfleas.

The utilization of bacterial phosphorus in zooplankton metabolism was investigated using radiophosphorus labelled natural bacteria as a food source for zooplankton in feeding experiments. Incorporation of labelled bacteria was clearly related to the species' ability to graze on bacteria, with the cladoceran Daphnia reaching the highest biomass-specific activity and the copepod Acanthodiaptomus reaching the lowest. Daphnia juveniles had a higher biomass specific uptake of phosphorus than Daphnia adults presumably because of the higher growth rates of juveniles, rather than age-specific differences in the ability to feed on bacteria. This assumption was supported by the observation that juveniles had the highest specific phosphorus content. Retention of ingested 32-P from labelled particles exceeded 80%, indicating higher assimilation efficiencies for phosphorus, than with carbon. In the investigated humic lake, approximately 75% of the phosphorus in grazable particles was bound in bacterial cells, making bacteria the most important source of phosphorus to the bacteriovorous zooplankton species. (Author's abstract)
W91-12383

DISTRIBUTION OF BENTHIC INVERTEBRATES ALONG A NATURAL TURBIDITY GRADIENT IN LAKE TEMISKAMING, ONTARIO-QUEBEC.
Waterloo Univ. (Ontario). Dept. of Biology.
R. M. Sallenave, and D. R. Barton.
Hydrobiologia HYDRB8, Vol. 206, No. 3, p 225-234, October 29, 1990. 7 fig, 4 tab, 30 ref. Natural Sciences and Engineering Research Council operating grant A2322.

Descriptors: *Benthic fauna, *Distribution patterns, *Lake Temiskaming, *Limnology, *Turbidity, Aquatic animals, Benthos, Biomass, Canada, Clays, Mesotrophic lakes, Oligotrophic lakes, Organic matter, Phosphorus, Species composition.

Lake Temiskaming, a rift valley lake on the Ontario-Quebec border, exhibits a permanent gradient of turbidity due to tributary streams which cut through clay deposits north of the lake. Concentrations of total phosphorus decrease from north to south, with values suggesting mesotrophic conditions. Concentrations of chlorophyll a were characteristic of oligotrophic lakes and showed little relationship to either turbidity or total P. Large numbers of Tubificidae were found at the northernmost sampling station at a depth of 50 m, probably reflecting the localized impact of allochthonous organic matter introduced by a tributary stream. The numerical abundance of benthic fauna was much lower and did not vary significantly among the six more southerly 50 m stations, but biomass declined from north to south as Heterotrissocladius oliveri replaced Pontoporeia hoyi. Numerical abundance did not differ significantly among stations at depths of 10 m, but biomass decreased from north to south reflecting the distributions of the largest species, Hexagenia sp. and P. hoyi. Intensive sampling on two transects showed that maximum numbers of invertebrates occurred in the profundal zone. While these results are significant with respect to the correlation between total P and zoobenthic biomass reported by other investigators, size selective predation by fish may also be important in controlling the distribution of benthic invertebrates in Lake Temiskaming. (Author's abstract)
W91-12384

MESOCOSM STUDIES ON THE INFLUENCE OF PHOSPHATE ENRICHMENT ON AMMONIUM AND NITRATE FLUX IN AN OLIGOTROPHIC LAKE.
Montana State Univ., Bozeman. Dept. of Biology.
W. K. Dodds, and J. C. Priscu.
Hydrobiologia HYDRB8, Vol. 206, No. 3, p 235-243, October 29, 1990. 7 fig, 3 tab, 29 ref. NSF Grant BSR-8700142.

Descriptors: *Ammonium, *Eutrophication, *Lakes, *Limiting nutrients, *Limnology, *Nitrates, *Nutrients, *Oligotrophic lakes, *Phosphates, *Phytoplankton, Bacterioplankton, Biochemistry, Biomass, Enrichment, Nitrogen isotopes, Phosphorus radioisotopes, Zooplankton.

The fate of 15-NH4(+) and 15-NO3(-) was followed in control and PO4(3-) enriched 1570 L mesocosms filled with epilimnetic water from an oligotrophic Rocky Mountain lake. Volumetric incorporation of 15-NH4(+) and 15-NO3(-) into phytoplankton and bacterioplankton (particulates between 280 and 0.7 micrograms), and crustacean zooplankton > 80 micrograms was enhanced by PO4(3-), but no increase in biomass specific rates of uptake by phytoplankton and bacteria occurred for either form of 15-N. Dilution of 15-NH4(+) by 14-NH4(+) and 15-NO3(-) by 14-NO3(-) was evident, indicating a regeneration of these nutrients, but regeneration rates were not effected by PO4(3-) enrichment. These results illustrate the strong trophic coupling between N dynamics and PO4(3-) enrichment in this system. (Author's abstract)
W91-12385

PHYSICO-CHEMICAL DISTURBANCES ASSOCIATED WITH SPATIAL AND TEMPORAL VARIATION IN A MEDITERRANEAN RIVER.
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2E.
W91-12395

EXPERIMENTAL EVIDENCE FOR NITROGEN LIMITATION IN A NORTHERN OZARK STREAM.
Missouri Univ.-Columbia. School of Natural Resources.
For primary bibliographic entry see Field 2E.
W91-12396

PHOSPHORUS AND NITROGEN DYNAMICS IN STREAMS DURING A WILDFIRE.
Montana Univ., Polson. Flathead Lake Biological Station.
For primary bibliographic entry see Field 2E.
W91-12397

NUTRIENT CYCLING BY BIOFILMS IN RUNNING WATERS OF DIFFERING NUTRIENT STATUS.
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2E.
W91-12398

EFFECTS OF DETRITUS LOADING AND FISH PREDATION ON LEAFPACK BREAKDOWN AND BENTHIC MACROINVERTEBRATES IN A WOODLAND STREAM.
North Carolina Univ. at Chapel Hill. Dept. of Biology.
S. R. Reice.
Journal of the North American Benthological Society JNASEC, Vol. 10, No. 1, p 42-56, March 1991. 9 fig, 3 tab, 32 ref. NSF Grant DEB-7680443.

Descriptors: *Benthic environment, *Detritus, *Fish diets, *Leaves, *Macroinvertebrates, *Mt Sinai Creek, Benthos, Fish populations, Forest watersheds, North Carolina, Organic matter, Species composition.

To test the roles of coarse particulate organic matter (CPOM) loading and fish predation on benthic community structure and leafpack breakdown, CPOM and fish density were manipulated in a stream. Mt. Sinai Creek, a 3rd-order stream in Piedmont North Carolina, was divided into twelve 30 sq m segments with 0.5 m high weirs. CPOM was loaded and maintained at 0.01 ambient, ambient and 4X ambient levels for 19 months. Fish were excluded from half the segments and maintained at natural densities in the others, in a fully cross-classified design. Neither CPOM loading nor fish predation had significant effects on leafpack breakdown and macrobenthic species richness or diversity in leafpack and sediment samples on all dates. The total abundance of invertebrates was reduced by fish in sediment samples but no in leafpacks. Almost all species were not significantly affected by the CPOM or fish treatments. Only two taxa responded to each treatment in sediments throughout the study, and none responded in leafpacks, i.e.g, less than 5% of the taxa tested. Interactions between fish and CPOM were rarely significant. CPOM loading and fish predation, and their interactions, were not major forces in determining the diversity, richness, or litter breakdown rates of this lotic community. The absence of a fish effect on the animals in leafpacks suggests that leafpacks function as a refuge from fish predation for macrobenthic invertebrates. The effect of fish predation on total individuals but not on populations in sediments suggests that fish feeding has a significant impact on the benthos, but that natural variability in population sizes can obscure this effect. (Author's abstract)
W91-12399

RELATIONSHIPS BETWEEN DEMOGRAPHIC FEATURES OF A PILL CLAM (PISIDIUM CASERTANUM) AND ENVIRONMENTAL VARIABLES.
Guelph Univ. (Ontario). Dept. of Zoology.
B. W. Kilgour, and G. L. Mackie.
Journal of the North American Benthological Society JNASEC, Vol. 10, No. 1, p 68-80, March 1991. 4 fig, 6 tab, 46 ref.

Descriptors: *Benthic environment, *Clams, *Ecosystems, *Environmental quality, *Population dynamics, Alkalinity, Biomass, Calcium, Conductivity, Hardness, Hydrogen ion concentration, Limnology, Productivity, Statistical analysis, Sulfates, Water temperature.

Seventeen populations of Pisidium casertanum from six rivers and eleven lakes were studied to determine how population demographics were related to environmental conditions. Univariate and multivariate analyses of the data suggest that natural variation in environmental conditions accounts for a significant amount of variation in the demography of this clam. Correlations among principal components of environmental variables and of population demographics were used to assess the relationships between environmental variables and population features. Abundance, production, and biomass were higher in habitats with warmer ice-free temperatures, but the length at which adults first developed shelled larvae, and maximum adult length and weight, were less in such habitats. Productivity, biomass, and the proportion of adults brooding shelled larvae were higher in habitats that had higher calcium hardness, conductivity, pH, alkalinity, and sulfate levels. These factors should be considered in studies that attempt to relate variation in population statistics of sphaeriid clams to environmental degradation. (Author's abstract)
W91-12400

DENSITY-DEPENDENT GROWTH, ECOLOGICAL STRATEGIES, AND EFFECTS OF NUTRIENTS AND SHADING ON BENTHIC DIATOM SUCCESSION IN STREAMS.
Louisville Univ., KY. Dept. of Biology.
For primary bibliographic entry see Field 2E.
W91-12422

NON-STEADY STATE DYNAMICS OF ALGAL POPULATION GROWTH: EXPERIMENTS WITH TWO CHLOROPHYTES.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Oekophysiologie.
J. P. Grover.
Journal of Phycology JPYLAJ, Vol. 27, No. 1, p 70-79, February 1991. 5 fig, 6 tab, 45 ref.

Descriptors: *Algae, *Growth rates, *Limnology, *Mathematical analysis, *Mathematical models, *Population dynamics, Culturing techniques, Droops equation, Nutrients, Phosphorus, Simulation analysis.

The relations among dissolved phosphorus, cell quota of P, and population growth rate were determined for two chlorophytes, Chlorella sp. and Scenedesmus quadricauda var. longispina (Chod.) G. M. Smith, in two types of non-steady state continuous culture. One type had a relatively smooth transition between growth under different degrees of P limitation. Under these conditions, two equations often applied to growth kinetics in

steady-state cultures, and were found to apply to non-steady state growth. Monod's equation described the relation between dissolved P concentration and population growth rate, and Droop's equation described the relation between cell quota and population growth rate. The second type of culture received P only as periodic pulses, leading to sharp changes in dissolved P, cell quota, and growth rate. A simulation model based on Droop's equation described much of the observed dynamics of cell numbers and quotas in these cultures. Droop's equation could not be convincingly fitted directly to the data, however, due to its incorrect prediction of an immediate growth response to P pulses. A third relation, predicting that saturated rates of P uptake would depend on the recent nutrient history of the cells as reflected by the cell quota was not supported. (Author's abstract)
W91-12423

AMMONIUM STIMULATION OF DARK CARBON FIXATION AS AN INDICATOR OF NITROGEN DEFICIENCY IN PHYTOPLANKTON: POTENTIAL ERRORS CAUSED BY AMMONIUM-OXIDIZING BACTERIA.
Montana State Univ., Bozeman. Dept. of Biology.
W. K. Dodds, and J. C. Priscu.
Journal of Phycology JPYLAJ, Vol. 27, No. 1, p 79-82, February 1991. 2 tab, 23 ref. NSF Grant BSR-8700142.

Descriptors: *Algae, *Ammonium, *Bacteria, *Carbon cycle, *Deficient elements, *Flathead Lake, *Limnology, *Nitrogen, *Phytoplankton, Ammonia bacteria, Bioassay, Carbon dioxide, Light effects, Microbiological studies, Montana, Nitrapyrin.

Stimulation of dark fixation of carbon by NH4(+) is often used as an indicator of phytoplankton N deficiency. This assay is based on the influence of available NH4(+) on anaplerotic CO2 fixation by algae. However, carbon fixation by chemoautotrophic NH4(+)-oxidizing bacteria may also be stimulated by NH4(+) enrichment, a process that can mask the algal response in natural communities. NH4(+) addition enhanced dark carbon fixation up to 300%, relative to unamended controls, in organisms collected on a 0.7 microm retention filter in oligotrophic Flathead Lake, Montana, but the effect was not detectable in the presence of nitrapyrin, an inhibitor of NH4(+)-oxidizing bacteria. Dark carbon fixation was enhanced by the addition of NH4(+) in organisms retained on 2-microm filters (which should allow passage of most bacteria). NH4(+) stimulated dark carbon fixation in N-deficient axenic cultures of Chlamydomonas reinhardtii Dang but not in N-replete cultures in both the presence and absence of nitrapyrin. Application of nitrapyrin or size fractionation treatments, to separate the processes of dark carbon fixation by nitrifiers and phytoplankton, may improve the efficacy of assays using NH4(+) stimulation of dark carbon fixation to specifically indicate N deficiency in natural algal communities. (Author's abstract)
W91-12424

NUTRIENT REQUIREMENTS OF THE DINOFLAGELLATE PERIDINIUM GATUNENSE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
K. Lindstrom.
Journal of Phycology JPYLAJ, Vol. 27, No. 2, p 207-219, April 1991. 13 fig, 49 ref. Swedish Natural Science Research Council 2051-011.

Descriptors: *Dinoflagellates, *Ecosystems, *Lake Kinneret, *Limnology, *Nutrient requirements, *Nutrients, *Selenium, Alkalinity, Biomass, Growth rates, Hydrogen ion concentration, Iron, Israel, Molybdenum, Nitrates, Phosphates, Salinity, Trace elements.

Optimum nutrient conditions for growth and photosynthesis of Peridinium gatunense (Nygaard)(Peridinium cinctum fa. westii) were investigated using axenic clones in batch cultures. Selenium (Se) had previously been found to be an indispensable growth factor for P. gatunense. Optimal, suboptimal, and supraoptimal concentrations of HCO3(-), N, Ca, Cl, Mg, P, K, S, Si, EDTA-Na, Fe, Mo, Zn, Mn, Co, Se, B, Br, I, and various trace element mixtures were determined by measuring biomass development, growth rates, 14-C uptake, and/or oxygen production at various concentration gradients of these elements. The general characteristics of the best formulation, medium-L 16, relative to other media, are its high concent of NaHCO3 (1 meq/L) and Mo (0.2 microM) but low concentrations of NO3-N (150 microM), PO4-P (10 microM), and Fe (0.4 microM), in addition tot its content of Se. The total content of trace metals, except for Se, may be reduced to one-fourth of that in medium-L 16 without altering the major growth promoting properties of the medium. Medium-L 16 deviated considerably from Lake Kinneret (Israel) water, being much lower i n macroelements except for N and P. The pH (8.1-8.4) was in the same range, but the values of conductivity (140 microS/cm), alkalinity (1 meq/L) and NaCl (200 microM) were > 8, 2, and 30 times higher, respectively, in the lake water. Selenium deficiency may limit the growth of P. gatunense in this lake. (Author's abstract)
W91-12425

COMPARISON OF PERIPHYTIC ALGAL BIOMASS AND COMMUNITY STRUCTURE ON SCIRPUS VALIDUS AND ON A MORPHOLOGICALLY SIMILAR ARTIFICIAL SUBSTRATUM.
Brandon Univ. (Manitoba). Dept. of Botany.
L. G. Goldsborough, and M. Hickman.
Journal of Phycology JPYLAJ, Vol. 27, No. 2, p 196-206, April 1991. 16 fig, 4 tab, 49 ref. NSERC Operating Grant A-6384.

Descriptors: *Algae, *Artificial substrates, *Biomass, *Bulrushes, *Ecosystems, *Limnology, *Periphyton, *Plant growth, Alberta, Aquatic plants, Macrophytes, Morphology, Photosynthesis.

Chemically inert, cylindrical rods positioned in the littoral of two eutrophic Alberta lakes supported higher periphytic algal biomass (measured as total chlorophyll a) than nearby morphologically similar culms of Scirpus validus Vahl. during most of the summer. Upon initiation of macrophyte senescence, biomass on the two substrata became more similar. Experiments were conducted to investigate the basis for these observations. Whole extracts of intact vegetative Scirpus culms had no effect on periphyton photosynthesis, suggesting that the natural substrata do not produce water-soluble allelochemicals. Various modifications of the rod surfaces (roughening, wax coating, was color) were used to test whether surficial properties of Scirpus culms influenced periphyton accumulation. Roughened rods, and both substrata developed structurally complex periphyton communities. Rods covered with paraffin wax had periphyton communities that were lower in biomass and structurally more simple than those on uncoated rods or on Scirpus culms. Coloring of the wax coating had not consistent effect on periphyton accumulation. Therefore, it was hypothesized that the hydrophobic cuticle on actively growing Scirpus culms retards the development of precursors for attachment by periphytic algae. Upon senescence of the culm and loss of epidermal integrity, colonization of culm surfaces by periphytic algae may occur in a manner similar to that on artificial substrata. (Author's abstract)
W91-12426

FACTORS RESPONSIBLE FOR RETARDING THE EUTROPHICATION RATE OF SOME MESOTROPHIC LOWLAND LAKES IN N.E. POLAND.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W91-12445

GROWTH OF BLUE-GREEN ALGAE IN THE SAIDENBACH RESERVOIR AND ITS RELATIONSHIP TO THE SILICON BUDGET.
Sachsische Akademie der Wissenschaften zu Leipzig, Arbeitsgruppe 'Limnologie von Talsperren,' Neunzehnhain, Germany.
H. Horn, and W. Horn.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 75, No. 4, p 461-474, 1990. 12 fig, 1 tab, 25 ref.

Descriptors: *Cyanophyta, *Germany, *Lake restoration, *Limiting nutrients, *Limnology, *Phytoplankton, *Reservoirs, *Saidenbach Reservoir, *Silicon, Cycling nutrients, Diatoms, Lake sediments, Mesotrophic lakes, Phosphorus, Plant growth, Seasonal distribution.

The phytoplankton succession during summer in the mesotrophic reservoir Saidenbach (Saxony, Germany; maximum depth 45 m, mean depth 15.3 m) since 1975 may be explained by the resource ratio hypothesis. Until 1980, only phosphorus controlled the phytoplankton growth, and diatoms prevailed because an excess of silicon existed. From 1981 to 1986, the ratio Si:P often was smaller than 90, a value critical for the development of the diatom Fragilaria crotonensis. Its reduced growth caused an increased occurrence of blue-greens (mostly Aphanothece clathrata) immediately after the diatom mass development. During these years phytoplankton was limited first by silicon in summer; later growth was limited by phosphorus. Because of increased Si and P load since 1987 a simultaneous limitation of both nutrients occurs. This leads now to parallel mass developments of diatoms and blue-greens. To maintain the positive effect of diatoms (phosphorus transport into the sediment), it is necessary to guarantee a sufficiently high Si:P ratio. If a reduction of P load is not possible, Si remobilization from the sediment could be increased by artificial changes of the water level. (Author's abstract)
W91-12446

DISTRIBUTION AND SEASONAL ABUNDANCE OF BENTHIC MACROINVERTEBRATES IN LAKE NAINI TAL, U.P., INDIA.
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-12447

DIEL VERTICAL MIGRATION OF DAPHNIA HYALINA (SENSU LATIORI) IN LAKE MAARSSEVEEN: PART 1. ASPECTS OF SEASONAL AND DAILY TIMING.
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
J. Ringelberg, B. J. G. Flik, D. Lindenaar, and K. Royackers.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 2, p 129-145, April 1991. 9 fig, 2 tab, 30 ref.

Descriptors: *Animal behavior, *Daphnia, *Diel migration, *Lake Maarsseveen, *Limnology, *The Netherlands, Fish behavior, Fish food organisms, Mesotrophic lakes, Vertical distribution, Waterfleas.

In Lake Maarsseveen (The Netherlands), a small mesotrophic lake (70 ha) with a maximum depth of about 30 m, the vertical depth distribution of Daphnia hyalina was studied from April to September 1989. Every 2 wk, around noon and midnight, samples were taken simultaneously at 7 depths ranging from 1.25 to 16.25 m. In addition, intensive sampling consisting of sampling every half hour starting 1 hr before sunset and 2.5 hr before sunrise and lasting for 3.5 hr was conducted on four occasions. Simultaneously, light intensity was registered continuously 20 cm below the water surface. From April 18 until May 21, juveniles, adults without eggs, and adults with eggs were distributed about equally over the first 7 m at both noon and midnight. Two weeks later, all categories performed a diel vertical migration (DVM). The period of DVM lasted until June 26. During this period juvenile perch fed actively on D. hyalina as evidenced by gut content analyses. The rapid development of this DVM appears to exclude selection of a migrating genotype. An exudate from juvenile perch may trigger this behavior. The intensive sampling program and light intensity studies confirmed that migratory behavior in the field in relation to light is comparable to that seen

in the laboratory. This supports the idea of a phenotypic induction of DVM by juvenile perch. (Author's abstract)
W91-12469

NITROGEN UPTAKE AND C:N:P RATIO OF EPIPHYTIC ALGAE IN THE LITTORAL ZONE OF LAKE KASUMIGUARA.
National Inst. for Environmental Studies, Tsukuba (Japan).
N. Takamura, and T. Iwakuma.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 2, p 161-170, April 1991. 2 fig, 2 tab, 20 ref.

Descriptors: *Algae, *Lake Kasumiguara, *Limnology, *Nitrogen, *Nutrients, *Periphyton, Ammonium, Japan, Limiting nutrients, Littoral zone, Nitrates, Phytoplankton, Seasonal variation, Ureas.

Information is scarce on the uptake of dissolved inorganic nitrogen (DIN) by periphyton despite the importance of this community in the littoral zone of lakes. The uptake rates of ammonium, nitrate, and urea by epiphytic and planktonic algae were measured in the emergent and floating-leaved macrophyte zones of the hypertrophic Lake Kasumiguara, Japan. A high selectivity of ammonium by epiphytic algae in comparison with nitrate or urea was observed. The uptake rates of ammonium by epiphytes were within the range observed previously for phytoplankton in the same lake. The epiphytic algae in this lake therefore were inferior to phytoplankton with respect to the utilization of both light and nitrogen. The C:N:P ratios (wt/wt) of algae indicated P deficiency among the epiphytes in May and July in the floating-leaved macrophyte zone. (Author's abstract)
W91-12470

PRIMARY PRODUCTION OF PHYTOPLANKTON IN AN OLIGO-MESOTROPHIC LAKE.
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
A. Vaquer, and M. El Hafa.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 2, p 203-217, April 1991. 6 fig, 1 tab, 28 ref.

Descriptors: *Algae, *Chlorophyll a, *France, *Limnology, *Phytoplankton, *Primary productivity, Calcium carbonate, Eutrophication, Nutrients, Sainte Croix Reservoir, Seasonal distribution, Temperature, Thermal stratification, Transparency, Vertical distribution.

The seasonal and vertical distribution of chlorophyll a concentrations and primary production were studied in the reservoir of Sainte Croix (Provence, France) during the 1985-1986 period. Variations of both chlorophyll a and primary productivity were similar from one year to the next. Chlorophyll a concentration generally varied between 0.1 and 3.5 mg/cu m. The average annual concentrations were 0.99 mg/cu m in 1985 and 1.08 mg/cu m in 1986. The maximum concentrations were measured between 2.5 and 10 m from January to June and on average at 15 m depth, coinciding with the mean depth of the euphotic zone, from July to November. Daily primary production (on average 245 and 93 mg C/sq m daily in 1985 and 1986, respectively) ranged between 7.8 and 722 mg C/sq m per day. Vertical profiles indicated inhibition of photosynthesis by light at the top of the water column, with maximum values always in the upper 2.5-10 m. The seasonal development and vertical distribution of phytoplankton typically depend on temperature and irradiance during the mixing period and on nutrients and biological factors during thermal stratification. Low water transparency suggests that calcium carbonate precipitation may limit phytoplankton development and play and important role against eutrophication. (Author's abstract)
W91-12472

STUDIES ON THE ECOLOGY OF AQUATIC BACTERIA OF THE LOWER NIGER DELTA: POPULATIONS OF VIABLE CELLS AND PHYSIOLOGICAL GROUPS.
Port Harcourt Univ. (Nigeria). Dept. of Microbiology.
M. T. Ogan.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 2, p 235-252, April 1991. 1 fig, 5 tab, 54 ref.

Descriptors: *Aquatic bacteria, *Biodegradation, *Bioindicators, *Niger Delta, *Nigeria, *Organic pollutants, Laboratory methods, Lotic environment, Niger River, Nutrients.

The viable cells and physiological groups of bacteria in the lotic waters of the Niger Delta were studied in the Port Harcourt area (Rivers State, Nigeria) and were related to indices of organic pollution. Based on decreasing pollution levels three zones were recognized. Casein-Peptone-Starch and Standard Plate Count agar media were employed to detect and quantify various types of aquatic bacteria (polymer hydrolyzers, crude oil and diesel degraders, aerobic actinomyctes, denitrifying bacteria, and sulfate-reducing bacteria). Nitrifying and iron bacteria were undetected even after incubation for 4 mo and 30 days, respectively. Significant correlations between water quality parameters and bacteria were found for the following combinations: nitrate:denitrifiers; nitrate:sulfate reducers; nitrate:phosphate; sulfate: sulfate reducers; and crude oil degraders:nitrifiers. (Author's abstract)
W91-12473

NUTRIENTS AND CHLOROPHYLL AT THE INTERFACE OF A WATERSHED AND AN ESTUARY.
Smithsonian Environmental Research Center, Edgewater, MD.
For primary bibliographic entry see Field 2L.
W91-12483

IDENTIFICATION OF BACTERIOCHLOROPHYLLS IN LAKES VIA REVERSE-PHASE HPLC.
Wisconsin Univ.-Madison. Center for Limnology.
J. P. Hurley, and C. J. Watras.
Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 307-315, March 1991. 6 fig, 2 tab, 20 ref.

Descriptors: *Aquatic bacteria, *Chemical analysis, *Chlorophyll, *High performance liquid chromatography, *Limnology, *Water analysis, Bacterial productivity, Laboratory methods, Lakes, Little Rock Lake, Pallette Lake, Pigments, Primary productivity, Wisconsin.

Reverse-phase high-performance liquid chromatography (HPLC) has been used successfully to quantify phytoplankton pigments in lakes and oceans. This technique has been extended to photosynthetic bacterioplankton and identification of five bacteriochlorophylls (BChl a, b, c, d, e) extracted from pure cultures with 90% has been demonstrated. This technique was applied to natural plankton samples from two oligotrophic-mesotrophic lakes in northern Wisconsin (Little Rock Lake, Pallette Lake). In both lakes, previously undetected layers of phototrophic bacteria were identified based on their pigment compositions. In one of the lakes, the bacterial layer previously had been misidentified as a deep zone of abundant pheopigment. These observations re-emphasize concerns that traditional protocols (i.e., measuring the absorbance of mixed acetone extracts at 665 nanometer before and after acidification) have serious limitations in natural systems and can lead to misinterpretations of planktonic distributions and processes. The potential importance of phototrophic bacteria in dimictic temperate lakes was demonstrated. Without significantly modifying standard reverse-phase HPLC protocols, unambiguous determinations of eukaryotic and prokaryotic chlorophylls and degradation products can be made simultaneously. (Author's abstract)
W91-12485

BIOLOGICAL AVAILABILITY OF DISSOLVED ORGANIC CARBON ALONG THE OGEECHEE RIVER.
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2K.
W91-12486

WATER TEMPERATURE DYNAMICS AND HEAT TRANSFER BENEATH THE ICE COVER OF A LAKE.
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
C. R. Ellis, H. G. Stefan, and R. Gu.
Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 324-335, March 1991. 15 fig, 16 ref.

Descriptors: *Heat transfer, *Iced lakes, *Limnology, *Thermal stratification, *Water temperature, Advection, Minnesota, Ryan Lake, Seasonal variation, Thermal diffusivity.

Stratification of lakes and reservoirs due to vertical temperature gradients is of central importance in describing and modeling lake hydrodynamics. Water temperature profiles were measured every 2 min in a small and shallow urban Minnesota lake (Ryan Lake, Minneapolis) from 8 February 1989 until ice-out on 11 April. The temperature record showed two distinct segments. Before 24 March, the temperature profile remained relatively constant, but later (when air temperatures were mostly above freezing) temperatures were dynamic and increased. During the quiescent period, the upper 3 m of the water column cooled slowly while the lower water remained virtually isothermal. The calculated thermal diffusion coefficient approached molecular thermal diffusivity near the ice cover and was roughly three times molecular diffusivity through much of the region of the thermocline (the upper 2 m). The average computed heat flux through the ice (50-55 cm thick) and snow (10-30 cm deep) cover during this period was 2.8 W/sq m. With onset of above-freezing air temperatures, water temperatures began to change rapidly. Observed intrusions of warm water most likely resulted from advected inflows of warm water from the periphery of the lake. (Author's abstract)
W91-12487

SIMILARITY OF WHOLE-SEDIMENT MOLECULAR DIFFUSION COEFFICIENTS IN FRESHWATER SEDIMENTS OF LOW AND HIGH POROSITY.
Limnologisch Inst., Nieuwersluis (Netherlands).
J. P. R. A. Sweerts, C. A. Kelly, J. W. M. Rudd, R. Hesslein, and T. E. Cappenberg.
Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 335-342, March 1991. 4 fig, 1 tab, 24 ref.
Natural Sciences and Engineering Research Council of Canada Grants OGPGP010 and STRGP036.

Descriptors: *Diffusion, *Diffusion coefficient, *Interstitial water, *Lake sediments, Heavy water, Isotope studies, Porosity, Prediction, Solute transport, Tritium.

Whole-sediment molecular diffusion coefficients (Ds) for tritiated water in pore waters of various lakes were determined experimentally by adding 3H20 to the overlying water of asphyxiated (without bioirrigation) and unasphyxiated cores and measuring the resulting pore-water profiles after a period of time. The objectives were to determine the relationship between Ds and the diffusion coefficient in pure water (Do) in sediments with a wide range of porosities and organic contents and to examine the influence of bioirrigation on solute transport and on the predictability of Ds. Do/Ds did not change as much as expected with increasing porosity. In low-porosity sediments the average Do/Ds was 1.8 +/-0.1 and in high-porosity sediments it was 1.5 +/-0.2. Also, the effect of faunal activity on the predictability of Ds was significant only in sediments with high invertebrate populations (14,000 individuals/sq m). This result means that in most freshwater systems the sediment diffusion coefficient can be predicted reliably from the molecular diffusion coefficient at in situ temperature (Author's abstract)
W91-12488

POST-1979 THERMOHALINE STRUCTURE OF THE DEAD SEA AND ROLE OF DOUBLE-DIFFUSIVE MIXING.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
D. A. Anati, and M. Stiller.

Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 342-354, March 1991. 7 fig, 2 tab, 12 ref.

Descriptors: *Dead Sea, *Density stratification, *Diffusion, *Limnology, *Meromixis, *Mixing, *Saline lakes, Brines, Chemical stratification, Climates, Israel, Salinity.

After centuries of meromixis (year-round stratification with a permanent halocline), the Dead Sea has passed through two distinct stages in the last decade: (1) a 4-yr meromictic stage and then (2) a holomictic stage. In the first stage, classic one-dimensional processes predominated. In the second stage, three different regimes operated in a seasonal cycle consisting of salt precipitation in spring and early summer, double-diffusive mixing in late summer and autumn, and vertical mixing in winter. During the second (holomictic) stage the Dead Sea as a whole exhibited a gradual change in the salt composition of its brines, an increase in salt concentration, and gradual heating. Assuming that this 9-yr example is typical of the geological evolution of the Dead Sea, the bulk of its brines have been subject to secular changes only during past holomictic periods. The present state, therefore, is a consequence not of past average climatic conditions, but of their interaction with the stability structure only during periods of particularly dry climate. (Author's abstract)
W91-12489

EFFECT OF WHOLE-LAKE FISH COMMUNITY MANIPULATIONS ON DAPHNIA MIGRATORY BEHAVIOR.
Louisiana State Univ., Baton Rouge. Dept. of Zoology and Physiology.
M. L. Dini, and S. R. Carpenter.
Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 370-377, March 1991. 2 fig, 2 tab, 25 ref. NSF Grants BSR 83-08918 and BSR 86-06271.

Descriptors: *Animal behavior, *Daphnia, *Lake ecology, *Limnology, *Predation, *Zooplankton, Ecosystems, Fish food organisms, Paul Lake, Tuesday Lake, Wisconsin.

Numerous hypotheses have been advanced to explain the advantages to zooplankton of diel vertical migration. A four-summer study of vertical migration by Daphnia was conducted in two neighboring lakes (Tuesday and Paul Lakes, Wisconsin) during two-stage fish community manipulation. This manipulation produced discrete periods of low and high planktivory by fish. The migration pattern was variable and weak during the low predation stage, but became consistent and intense within weeks of the change to high levels of predation, confirming the pre-eminence of predation avoidance among several extant hypotheses. (Author's abstract)
W91-12490

PREDICTIONS OF SURFICIAL SEDIMENT COMPOSITION IN THE LITTORAL ZONE OF LAKES.
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
E. L. Petticrew, and J. Kalff.
Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 384-392, March 1991. 4 fig, 4 tab, 23 ref.

Descriptors: *Lake Memphremagog, *Lake sediments, *Limnology, *Littoral zone, *Sediment transport, Hydrologic models, Mathematical models, Particulate matter, Quebec, Sediment focusing.

Lacustrine sediment focusing presumes the removal of fine-grained littoral particles (silt and clay) to storage sites in the deeper, less productive zone of a lake. In the littoral zone, shorter term sediment storage, on the time scale of biological transfers, demands attention as these clays and silts represent potential vectors in aquatic contaminant transfers. Two empirical models that predict surficial fine-grained sediment composition of the littoral were developed in Lake Memphremagog (Quebec). A five-variable model explained 67% of the variance in the proportion of clay at 62 nearshore sites. A three-variable model including measures of fetch, depth, and slope explained 58% of the variance, whereas the additional variables of plant presence or absence and sediment organic matter contributed the remaining 9% of explained variation. The two models performed exceedingly well when tested at 41 sites not used in the original derivation of the model. Of these 41 test sites, 13 represent samples from littoral zones of five eastern Canadian lakes (maritime provinces) representing different geologies and morphologies. (Author's abstract)
W91-12491

SEDIMENT ACCUMULATION RATES IN CONOWINGO RESERVOIR AS DETERMINED BY MAN-MADE AND NATURAL RADIONUCLIDES.
Maryland Dept. of Natural Resources, Annapolis. Power Plant and Environmental Review.
For primary bibliographic entry see Field 2J.
W91-12498

GROWTH, DECOMPOSITION, AND NUTRIENT RETENTION OF CLADIUM JAMAICENSE CRANTZ AND TYPHA DOMINGENSIS PERS. IN THE FLORIDA EVERGLADES.
South Florida Water Management District, West Palm Beach.
S. M. Davis.
Aquatic Botany AQBODS, Vol. 40, No. 3, p 203-224, June 1991. 8 fig, 2 tab, 40 ref.

Descriptors: *Cattails, *Decomposition, *Everglades, *Limnology, *Nutrients, *Plant growth, *Wetlands, Florida, Litter, Nitrates, Nitrogen, Phosphorus, Saw grass, Seasonal variation.

Annual rates of P and N allocation to growing leaves, translocation or leaching from dying leaves, and retention in dead leaves of Cladium jamaicense Crantz and Typha domingensis Pers. were correlated to soluble reactive P and nitrate concentrations in surface water, in the Florida Everglades. Rates of each of these processes were higher in T. domingensis than in C. jamaicense. Cladium jamaicense rates increased linearly along the nutrient gradients, but did not fluctuate with yearly variations in soluble reactive P or nitrate concentrations. For T. domingensis, annual rates were strongly correlated with mean annual soluble reactive P and nitrate concentrations during specific sampling years. Responses of C. jamaicense to the nutrient gradient were characteristic of species competitive in an infertile habitat, while responses of T. domingensis were characteristic of species competitive in a fertile habitat. The main effect of P and N enrichment on leaf nutrient flux was to accelerate translocation or leaching from dying tissue, rather than to increase retention in standing dead leaves. Freshly dead leaves retained only slightly greater quantities of P and N under enriched conditions in comparison to background conditions. After 2 years of decomposition, approximately half of the leaf litter mass remained intact. Increasing P and N concentrations in decomposing leaf litter resulted in net uptake or retention of these elements after 2 years despite decreasing litter mass. The total amounts of P and N that were sequestered annually by T. domingensis after processes of leaf production, mortality and 2 years decomposition were lowest under non-enriched conditions and reached a maximum under a moderate level of enrichment. Wetland ecosystems such as the Everglades, which developed under conditions of low nutrient supply, may offer a finite potential for accelerated nutrient retention when the exogenous nutrient supply increases as a result of human activities. However, a plant species such as C. jamaicense, that is adapted to a low-nutrient environment, may have a low nutrient threshold before it loses its competitive capability and its habitat is invaded by a species such as T. domingensis that is better adapted to a high nutrient environment. (Author's abstract)
W91-12514

SEDIMENT AND WATER AS SOURCES OF NITROGEN AND PHOSPHORUS FOR SUBMERGED ROOTED AQUATIC MACROPHYTES.
Auckland Univ. (New Zealand). Dept. of Botany.
M. R. Rattray, C. Howard-Williams, and J. M. A. Brown.
Aquatic Botany AQBODS, Vol. 40, No. 3, p 225-237, June 1991. 5 fig, 4 tab, 35 ref. DSIR Research Contract 131DSIR53.

Descriptors: *Aquatic plants, *Eutrophic lakes, *Lake sediments, *Limnology, *Macrophytes, *Nitrogen, *Nutrients, *Phosphorus, Lake Rotorua, Lake Taupo, Oligotrophic lakes.

Two rooted submerged freshwater macrophytes (Lagarosiphon major (Ridley) Moss: Myriophyllum triphyllum Orchard) grown in large in situ experiments in two lakes of differing trophic status (Lake Taupo, oligotrophic; Lake Rotorua, eutrophic), exhibited two different nutrient limitations. Plants were grown on both oligotrophic and eutrophic sediments in each of the lakes. In the oligotrophic lake, plants grown on the eutrophic sediments were approximately twice the size of those grown on the oligotrophic sediments. Tissue nutrient analysis demonstrated that phosphorus levels were approximately doubled in plants grown on the eutrophic sediments, suggesting that phosphorus was limiting the growth of plants grown on the oligotrophic sediments. In the eutrophic lake, this sediment-related response was negligible with no consistent differences between the plants grown on the different sediment types. As the sediments were comparable in all the experiments, this suggested that the water phase was playing a role in the nutrition of these species. (Author's abstract)
W91-12515

VEGETATION DYNAMICS AND SEED BANKS OF A MONSOONAL WETLAND OVERGROWN WITH PASPALUM DISTICHUM L. IN NORTHERN INDIA.
Iowa State Univ., Ames. Dept. of Botany.
B. A. Middleton, A. G. Van der Valk, D. H. Mason, R. L. Williams, and C. B. Davis.
Aquatic Botany AQBODS, Vol. 40, No. 3, p 239-259, June 1991. 1 fig, 6 tab, 33 ref. Smithsonian Grant No. 4013600.

Descriptors: *India, *Limnology, *Monsoons, *Plant growth, *Seeds, *Wetlands, Precipitation excess, Seasonal variation, Species composition, Vegetation.

Wetlands in the Keoladeo National Park, Bharatpur, India, have been dominated by the grass Paspalum distichum L. since the removal of cattle and water buffalo from the park in the early 1980s. The mean water depth was lowest just before the onset of monsoon, highest immediately after it, and then declined slowly over the winter and spring. The mean cover of P. distichum was also lowest just prior to the onset of the monsoon (e.g. 19% in June 1984), increased after the monsoon (e.g. 35% in October 1985) and did not reach its maximum until late winter (e.g. 47% in March 1985). There was relatively little change in the species composition of the vegetation over an annual cycle. Because of the poor monsoon in 1986, water depths were much lower during the post-monsoonal period than normal. The cover of P. distichum was also reduced during this period and fell to only 2% by March 1987. The seed banks of areas dominated by Paspalum and four other emergent species contained a total of 55 species and between 1100 and 3100 seeds/sq m. Seeds of P. distichum were found in all vegetation types. Paspalum-dominated areas grazed by geese had a seed bank that contained 44 species and a mean of about 1000 seed/sq m. Only goose droppings collected in November contained viable seeds, of which 90% were Pasapalum seeds. Paspalum litter (6 cm or more) reduced recruitment from the seed bank by about 80% and the number of species recruited by about 50%. Only 12 species (total seedling density < 1 seedling/sq m) became established in openings created in the grass mt by geese during a summer drawdown. In an area where Paspalum was removed with bulldozers, the post-monsoonal vegetation was dominated by submersed and floating-leaved species. Paspalum was initially present at very low cover (0.1%) and increased to 4.6% in the next 9 months. (Author's abstract)

W91-12516

LEAD AND MOLYBDENUM IN REED AND CATTAIL--OPEN VERSUS CLOSED TYPE OF METAL CYCLING.
Polish Academy of Sciences, Mikolajki. Hydrobiological Research Station.
For primary bibliographic entry see Field 5B.
W91-12517

ENVIRONMENTAL EFFECTS ON CO2 EFFLUX FROM WATER TRACK AND TUSSOCK TUNDRA IN ARCTIC ALASKA, U.S.A.
Florida International Univ., Miami. Dept. of Biological Sciences.
S. F. Oberbauer, J. D. Tenhunen, and J. F. Reynolds.
Arctic and Alpine Research ATLPAV, Vol. 23, No. 2, p 162-169, May 1991. 3 fig, 3 tab, 26 ref. U.S. Department of Energy OHER/ERD Grant DE-FG03-84ER60250.

Descriptors: *Alaska, *Arctic zone, *Carbon dioxide, *Global warming, *Soil water, *Tundra, *Wetlands, Seasonal variation, Temperature, Thaw, Water table fluctuations.

CO2 efflux and variation in soil environmental characteristics were examined in two tundra vegetation communities, water track (a small drainage of intermittent water flow) and tussock tundra, in the northern foothills of the Philip Smith Mountains in arctic Alaska. Correlation analyses were performed on the observations made at six times during the growing season in order to evaluate the relationships between system CO2 loss and soil moisture, soil temperature, depth of thaw, and depth to the water table. The two sites differed significantly in terms of soil moisture, soil temperature, depth of thaw, and water table depth on several of the sampling dates. During four of the six measurement periods, the rate of CO2 efflux differed significantly between sites. Early in the season, respiration was greater in tussock tundra than at the water track, but later in the season, rates at the water track exceeded those at the tussock site. Highest rates were measured at the water track near mid-season. Efflux of CO2 at both sites was positively correlated with soil temperature. Soil surface environmental conditions were better predictors of CO2 efflux than were conditions measured at greater depth. Soil moisture appeared to increase respiration between 100 and 700% of soil dry weight and decrease soil respiration at higher water contents. The effects of soil moisture were stronger in tussock tundra than in the water track community. These data suggest that both soil temperature and soil moisture limit CO2 efflux in water track and tussock tundra communities and that the relative importance of these factors changes throughout the growing season. (Author's abstract)
W91-12539

MICROBIAL LARVICIDES FOR THE CONTROL OF NUISANCE AQUATIC MIDGES (DIPTERA: CHIRONOMIDAE) INHABITING MESOCOSMS AND MAN-MADE LAKES IN CALIFORNIA.
California Univ., Riverside.
For primary bibliographic entry see Field 4A.
W91-12550

IDENTIFICATION OF A MECHANISTIC MODEL FOR THE DIURNAL DISSOLVED OXYGEN PATTERN IN LAKES WITH DISCRETE TIME SERIES ANALYSIS.
Agricultural Univ., Wageningen (Netherlands). Dept. of Agricultural Engineering.
G. van Straten, and J. P. M. Kouwenhoven.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 17-23, 1991. 2 fig, 2 tab, 5 ref.

Descriptors: *Dissolved oxygen, *Diurnal variation, *Limnology, *Model studies, *Time series analysis, Calibrations, Data interpretation, Discrete time models, Model testing, Water chemistry.

The dissolved oxygen (DO) concentration in a lake shows a diurnal pattern due to photosynthesis by plants and algae during the daylight hours. This daily variation creates difficulties in the interpretation of samples taken occasionally by water boards to examine the violation of a DO standard. A model relating DO patterns to incident light may help to set guidelines for optimal sampling and to set safety margins for standards violation. A first-order autoregressive model with exogenous variables (ARX) has been developed to describe the diurnal dissolved oxygen pattern in a lakes; discrete time data analysis indicates that ARX is sufficient for this purpose and that is equivalent to a simple three parameter mechanistic model, augmented with a first-order noise filter. The noise dynamics can be interpreted in terms of natural stochastic parameter variations. Tests with data simulated with the identified stochastic model structure reveal that the usual least squares (LSQ) fitting of the mechanistic model without the noise term leads to biased parameter estimates. Therefore, with the actually measured data, ARX parameter estimates are probably preferable to LSQ estimates, even though the output error is larger. In the true system, slow parameter variations probably also occur which are not covered by the simple model. (See also W91-12568) (Korn-PTT)
W91-12571

NUTRIENT MODEL FOR A LAKE WITH TIME-VARIABLE VOLUMES.
National Taiwan Univ., Taipei. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W91-12584

ASSESSMENT OF EUTROPHICATION CONTROL PROGRAMS USING AN ECOLOGICAL MODEL FOR A DIMICTIC LAKE.
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
For primary bibliographic entry see Field 5G.
W91-12609

WATER QUALITY OF LAKES AND STREAMS IN VOYAGEURS NATIONAL PARK, NORTHERN MINNESOTA, 1977-84.
Geological Survey, St. Paul, MN. Water Resources Div.
G. A. Payne.
Available from the Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4016, 1991. 95p, 21 fig, 14 ref. Project No. MN 068.

Descriptors: *Cycling nutrients, *Limnology, *Minnesota, *Thermal stratification, *Voyageurs National Park, *Water quality, National parks, Water chemistry.

Investigations of six interconnected lakes in Voyageurs National Park in northern Minnesota during 1977-84 revealed substantial differences in water quality. Sand Point, Namakan, Rainy Lakes, near the eastern and northern boundaries of the Park, were oligotrophic to mesotrophic, having low dissolved solids and alkalinity, and were dimictic. In contrast, Kabetogama Lake, Black Bay, and Sullivan Bay, near the western and southern boundaries of the Park, were eutrophic, having higher dissolved solids and alkalinity than Sand Point, Namakan, and Rainy Lakes, and were polymictic. Chemical characteristics of lakes along the eastern and northern boundary were similar to those of the Namakan River--a major source of inflow that drains an extensive area of exposed bedrock and thin noncalcareous drift. Lakes along the western and southern boundary receive inflow from streams that drain an area overlain by calcareous drift. The nutrient-enriched lakes had high algal productivity that produced blooms of blue-green algae in some years. The polymictic lakes experienced seasonal increases in total phosphorus in their euphotic zones that were absent in the dimictic lakes; this indicates a link between the frequent recirculation in these lakes and internal cycling of phosphorus. Nearly all the 19 lakes in the Park's interior were sharply stratified and had low dissolved solids and alkalinity. Approximately half were characterized by total phosphorus concentrations that ranged from 3.0 to 10 micrograms per liter and chlorophyll a that ranged from 0.1 to 2.0 micrograms per liter. Trophic state declined from spring to summer in five lakes. Water quality in the Namakan River was better than its receiving water, but water in the Ash River generally was poorer than the quality in its receiving waters based on dissolved solids, nutrient concentrations, and algal productivity. (USGS)
W91-12654

FISHES IN THE FORESTED FLOOD PLAIN OF THE OCHLOCKONEE RIVER, FLORIDA, DURING FLOOD AND DROUGHT CONDITIONS.
Geological Survey, Tallahassee, FL. Water Resources Div.
H. M. Leitman, M. R. Darst, and J. J. Nordhaus.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4202, 1991. 36p, 10 fig, 5 tab, 102 ref. Project No. FL-476.

Descriptors: *Fish, *Flood plains, *Florida, *Forested wetlands, *Ochlockonee River, *Wetlands, Bottomland, Fish habitat, Fish populations, Floodplain hydrology, Hardwood, Riparian vegetation, Species diversity.

The importance of the flood plain environment to Ochlockonee River fishes was assessed in a cooperative study by the U.S. Geological Survey and the Florida Game and Fresh Water Fish Commission. Forty-eight species of fishes were collected in flood plain, backwater, and main channel habitats by five different sampling methods. During floods, three quarters of the fish species known to occur in the main channel were collected in the flood plain. Thirteen species were collected in flood plain ponds that were isolated from the river for 8 to 13 months during a drought. Seven common flood plain species were rare or absent in the main channel. Flood plain habitats were diverse with respect to hydrologic conditions and vegetation. The fluctuating hydrologic regime of the river flood plain system, along with the variety of alluvial features and tree communities, contribute to diversity in the fish community. Flood processes such as erosion and sediment deposition create topographic relief on the flood plain surface allowing diverse habitats to develop. Riverbank levees serve as berms during low and medium river stages, separating still water habitats in ponds and depressions from the flowing waters of the main channel. During low water, flood plain ponds support a fish community distinctly different from that of flowing waters of the main channel. During high water, flood plain ponds mix with flood waters and all river flood plain fishes gain access to diverse forest habitats. (USGS)
W91-12663

PHOSPHATASE ACTIVITY IN SEDIMENTS OF THE LOOSDRECHT LAKES.
Limnologisch Inst., Nieuwersluis (Netherlands).
A. J. C. Sinke, A. A. Cornelese, and T. E. Cappenberg.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 719-721, March 1991. 2 fig, 1 tab, 13 ref.

Descriptors: *Enzyme activity, *Eutrophic lakes, *Eutrophication, *Lake sediments, *Limnology, *Loosdrecht Lakes, *Phosphatases, *Sediment chemistry, *The Netherlands, Chlorophyll a, Organic matter, Particle size, Phosphorus, Phosphorus cycle, Physical properties, Soil types.

As part of eutrophication studies, phosphorus regeneration in sediments has received considerable attention. The phosphatase activity in sediments of the eutrophic Loosdrecht lakes was examined for relationships with dry weight, organic matter content and chlorophyll a content. The Loosdrecht lakes are a series of interconnected lakes which are man-made through peat mining in the 17th century. Sediment columns were obtained at random locations in the Loosdrecht lakes using a hand-

driven stainless steel corer containing a perspex inner core 40 cm long with an internal diameter of 5 cm. Phosphatase activity was determined using a modification of a method using p-nitrophenol phosphate as a substrate. Sediment samples were extracted with hot (80 C) 96% ethanol (final concentration 90%) for 10 minutes. The sediment columns could be divided into three types (gyttjja, peaty and sandy sediments), based upon differences in dry weight, structure, and organic matter content. Phosphatase activity decreased rapidly with depth in all sediment types. The amount of chlorophyll a decreased with depth in all sediment types and was highly correlated to phosphatase activity. The data for both phosphatase activity and chlorophyll a concentrations, conform well to the general distribution of labile organic substrates predicted from diagenic models for sedimentary environments. Differences between the gyttjja and the peaty sediment, were attributed to a difference in input of organic matter which was higher for the wind-sheltered gyttjja sediments. (Brunone-PTT)
W91-12664

SORPTION AND RELEASE OF PHOSPHORUS IN A PEATY SEDIMENT.
Limnologisch Inst., Nieuwersluis (Netherlands).
P. Keizer, M. C. N. P. Buysman, and T. E. Cappenberg.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 722-725, March 1991. 4 fig, 10 ref.

Descriptors: *Adsorption, *Eutrophic lakes, *Eutrophication, *Lake sediments, *Limnology, *Loosdrecht Lakes, *Phosphorus, *Sediment chemistry, *The Netherlands, *Turbidity, Ammonium, Cyanophyta, Nutrient concentrations, Phosphates, Suspended sediments, Transparency.

In the recent past, the Loosdrecht lakes have changed from a clear lakes into a highly turbid system with Secchi disk readings of about 0.3 m. Transparency is low due to a permanent dominance of blue-green algae and the presence of resuspended sediment material. Since 1984, the inlet water has been dephosphorized by FeCl3, reducing the annual external phosphorus load from 35 to 10 nmol/sq m/year. Experiments were conducted using intact sediment cores in which 50% of the water in the columns was used for phosphate and ammonium analysis, and replaced by fresh artificial lake water, twice a week. The phosphate release under aerobic conditions varied between 0 and 6 micromol/sq m/day. Under anaerobic conditions the release rate gradually increased during the first thirty days to a constant level of approximately 60 micromol/sq m/day. Ammonium release, monitored only during the last month of the experiment, was constant at 1.25 mmol/sq m/day. These results demonstrate that long term effects of hydroxide additions may be small, or that most of the phosphorus was transported to deeper layers by a downward water flow. In the latter case, an average of 0.02 nmol P/sq m/year must have been removed from the top of the sediment during the past 50 years. Results from the uptake experiments demonstrate that the ability of sediment cores to adsorb phosphate rapidly decreases once the sediment becomes anaerobic, clearly indicating that in lakes with a significant seepage and a relatively low sediment adsorption capacity, downward transport of phosphorus deserves to be examined thoroughly before dredging or hydroxide additions are applied as additional restoration measurements. At present, the external phosphorus load is only slightly smaller than the extraction from the top sediment layer. (Brunone-PTT)
W91-12665

ROLE OF DETRITUS IN THE PHOSPHORUS BALANCE OF LAKE LOOSDRECHT WATER.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
M. Rijkeboer, and H. J. Gons.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 726-728, March 1991. 4 fig, 11 ref.

Descriptors: *Detritus, *Eutrophication, *Limnology, *Loosdrecht Lakes, *Nutrients, *Phosphorus, Algae, Buffering, Chlorophyll, Dissolved oxygen, Lake restoration, Mixing, Phosphates, Phosphorus cycle, Phytoplankton, Seasonal variation, Sediment load, The Netherlands, Transparency, Water temperature.

The shallow Lake Loosdrecht (The Netherlands) is almost completely wind-mixed and, due to high phytoplankton and detritus concentrations the Secchi disk visibility during summer is approximately 0.3 m. The extent of the phosphorus flow into the particulate pool was investigated by inactivating the phytoplankton in the lake, in laboratory scale enclosures (LSE), by keeping the water dark and lowering the temperature to 10 C. The time courses in chlorophyll and dry weight were nearly identical, suggesting that the growth of the algae in these LSEs had been stopped. This conclusion was supported by the lack of change in dissolved oxygen concentration. The time course of total phosphorus concentration could be adequately predicted from initial concentration, loading and dilution rates. After three to four days of saturated loading, the soluble reactive phosphorus (SRP) input surpassed the particles' capacity for phosphorus uptake, as indicated by the increasing SRP concentration. Dissolved organic phosphorus compounds had low concentrations throughout the experimental period. The similarity in the obtained phosphorus balances at saturated phosphorus loading with both growing and inactivated algae, were explained by the adsorption of phosphorus onto detrital particles in the seston. Phosphate buffering explains why SRP concentrations in Lake Loosdrecht were almost always <10 microg P/L, even during winter. Control of the concentration of dissolved phosphate by detrital particles could considerably retard the restoration process in Lake Loosdrecht, since hydraulic loss of phosphorus from this seepage lake will be reduced. (Brunone-PTT)
W91-12666

DIATOM SEDIMENTATION LOSS REDUCTION BY RESUSPENSION IN SHALLOW LAKES.
H. J. Gons.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 729-733, March 1991. 3 fig, 18 ref.

Descriptors: *Cyanophyta, *Diatoms, *Eutrophic lakes, *Limnology, *Loosdrecht Lakes, Lake Breukeleveen, Lake Vuntus, Seasonal variation, Stratification, Suspended solids, Temperature, The Netherlands.

The very shallow, highly eutrophic Loosdrecht lakes remain completely wind-mixed in summer. During recent years, the plankton composition was almost always dominated by filamentous cyanobacteria, but fairly high population densities of diatoms, mainly Melosira spp., occurred in spring and autumn. The potential role of sedimentation rate reduction by resuspension was hypothesized for the coexistence of Melosira spp. in the phytoplankton of Lake Loosdrecht, Lake Breuleleveen and Lake Vuntus. As a group, the diatoms showed periodicity like that encountered in relatively deep lakes with summer stratification, and considerably less seasonal variation in the epipelon thand did other plankton. Sedimentation rates computed for Lake Loosdrecht and the other two lakes were 0.27 and 0.35/day oat O C in March, and 0.54 and 0.69/day at 25 C in July. These summer rates come close to half of the maximum growth rates of many diatoms; sedimentation rates alone may prevent successfull diatom competition with the cyanobacteria. Sedimentation rate reductions were greatest in Lake Breukeleveen and least in Lake Vuntus. The diatoms experience adverse conditions, for maintenance in the water column, under ice cover and in the summer. (Brunone-PTT)
W91-12667

AEROBIC DECOMPOSITION OF SETTLED ALGAE IN A LABORATORY SYSTEM: THE IMPACT OF RESUSPENSION ON MICROBIAL ACTIVITY.
Limnologisch Inst., Nieuwersluis (Netherlands).
J. Otten, and H. J. Gons.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 734-737, March 1991. 3 fig, 20 ref.

Descriptors: *Aerobic conditions, *Decomposition, *Eutrophic lakes, *Limnology, *Loosdrecht Lakes, *Microbiological studies, *Suspended solids, Algal physiology, Cyanophyta, Diatoms, Nutrient concentrations, Phosphorus, Respiration, The Netherlands.

In Lake Loosdrecht epipelic particles are frequently suspended and redeposited. The impact of resuspension on microbial activity, especially respiration rate, was investigated in the epipelic layers derived from seston in Lake Loosdrecht water. Aerobic decomposition of blue-green algae and epipelon was followed for three weeks in the laboratory. Epipelic respiration during the decomposition of phosphorus-saturated blue-green algae was higher than in the case of phosphorus-starved algae, mean dry weight specific respiration rates being 2.8 and 2.0 mg O2/g/hour, respectively. The dry weight specific respiration rates in layers in which the blue-green algae were predominant appeared to be higher than during decomposition in layers in which both cyanobacteria and diatoms were abundant. In experiments with Oscillatoria limnetica most organic material was decomposed rapidly, but about 10% of the initial dry weight was refractory; these algal remnants accumulate in epipelon. Refractory fractions of epipelon, after 3 weeks of loading from a culture of blue-green algae, were found to vary between 55% to 80% on a dry weight basis. Decomposition of this refractory part of the epipelon was very slow. Respiration rates related to the non-refractory part were 9.3 mg O2/gm/hr for epipelon derived from seston with mainly phosphorous-saturated blue-green algae, and 3.7 mg O2/gm/hr in cases when both blue-green algae and diatoms had been abundant in the seston. Since increased respiration rates were only observed under low dissolved inorganic phosphorus conditions during the decomposition of phosphorus-limited algae, phosphorus availability seems to be important in restricting the activity of the decomposers in the epipelon. (Brunone-PTT)
W91-12668

MODELLING BIOMASS AND OXYGEN DYNAMICS OF PROCHLOROTHRIX HOLLANDICA IN LABORATORY-SCALE ENCLOSURES.
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
M. T. Auer, and M. Rijkeboer.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 738-741, March 1991. 2 fig, 9 ref.

Descriptors: *Algal physiology, *Biomass, *Limnology, *Loosdrecht Lakes, *Model studies, *Oxygen requirements, *Water quality, Data interpretation, Dissolved oxygen, Growth kinetics, Light intensity, Mass balance, Mathematical models, Photosynthesis, Phytoplankton, The Netherlands.

A comprehensive program is currently in progress to study the impact of external phosphorus loading reductions on water quality in the Loosdrecht Lakes, The Netherlands. Coefficients of the light-limited growth of Prochlorothrix hollandica (a prokaryotic alga) were utilized to model short-term dynamics in biomass production and oxygen evolution in large, continuous flow, laboratory scale enclosures. Simulation of both biomass and dissolved oxygen dynamics in the enclosures is based on the mass balance between biomass and oxygen. Four steady states were achieved (0.042, 0.043, 0.081, and 0.169/day) yielding steady state biomass levels of 88, 70, 52, and 26 mg DW/L, respectively. The fit of model output to observed concentrations of oxygen and biomass was excellent, indicating that this conceptual framework suitably describes the light-limited growth of Prochlorothrix hollandica and that the model may

have value in future application to the Loosdrecht Lakes system. The model was able to successfully simulate short-term dynamics in dissolved oxygen and algal biomass using a single set of kinetic coefficients which were estimated using results from continuous culture studies and from short-term measurements of photosynthesis. This method also appears promising for a future application to natural phytoplankton assemblages from the Loosdrecht Lakes. (Brunone-PTT)
W91-12669

FIRST ATTEMPT TO MEASURE THE CLEARANCE RATE OF ANURAEOPSIS FISSA.
Limnologisch Inst., Nieuwersluis (Netherlands).
A. L. Wilms, R. D. Gulati, and G. Postema.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 742-744, March 1991. 2 tab, 12 ref.

Descriptors: *Aquatic animals, *Clearance rates, *Crustaceans, *Feeding rates, *Invertebrates, *Limnology, *Loosdrecht Lakes, *Rotifers, Algae, Assimilation efficiency, Chlorophyta, Contamination, Metabolism, Nutrients, The Netherlands.

The gut passage time, the clearance rate at different food concentrations, and the assimilation efficiency of the rotifer Anuraeopsis fissa were investigated using the 14-C labelled Chlorella vulgaris as food. The contamination by algae remaining on the filter while separating the rotifers from the experimental food was approximately 1% of the total radioactivity of the experimental suspension. Clearance rates in Anuraeopsis ranged from 0.04 to 3.48 microL/rotifer/hour, and assimilation efficiency was highly variable. Results yielding a four-fold difference between replicates, a contamination sometimes exceeding the rotifer radioactivity, and assimilation efficiencies $> 100\%$ suggest that the method needs refining and that more replicates are needed. The clearance rates values were the most reliable values, because rotifer numbers were high, contamination was low, and three replicates were used. The assimilation efficiencies of $>100\%$ can only be explained by the transfer of labelled algae adhering to the rotifers from the non-radioactive food and their subsequent consumption by the rotifers. If Anuraeopsis fissa prefers detritus to living algae, this might explain the low clearance rate. In Lake Loosdrecht, Anuraeopsis fissa may, even though restricted to a lower seston size fraction than the crustaceans, exceed the mean grazing rate of 13 to 22%/day of the crustacean community. (Brunone-PTT)
W91-12670

CLEARANCE RATES OF BOSMINA SPECIES IN RESPONSE TO CHANGES IN TROPHY AND FOOD CONCENTRATION.
Limnologisch Inst., Nieuwersluis (Netherlands).
R. D. Gulati, C. Vuik, K. Siewertsen, and G. Postema.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 745-750, March 1991. 3 fig, 1 tab, 21 ref.

Descriptors: *Clearance rates, *Eutrophic lakes, *Lake Vechten, *Limnology, *Loosdrecht Lakes, *Nutrients, *Trophic status, *Waterfleas, Algal blooms, Chlorophyta, Copepods, Feeding rates, Seasonal variation, Succession, The Netherlands, Transparency, Zooplankton.

The differences in the effect of varying concentrations of natural seston food and laboratory-cultured Chlorella sp. on the clearance rates of Bosmina longirostris and Bosmina coregoni, from lakes varying greatly in trophic state (Lake Vechten and the Loosdrecht lakes) were investigated. The eutrophic waters were characterized by massive blooms of filamentous cyanobacteria, recurrent and persistent from summer to early autumn. The Seston concentrations exceeded 10 mg C/L, so that Secchi disk visibility was low, 30 to 0 cm. Beside bosminids and chydorids, cyclopoids dominate the crustacean zooplankton population. In the Loosdrecht lakes, though clearance rates varied widely, a correlation with food concentration was lacking. The regression relationships between food concentration and clearance rates were significant, however, for both the Bosmina spp. In Dutch eutrophic waters, despite the lowering of the Bosmina clearance rate to a mean rate of 0.3 to 0.4 mL/individual/L, the animals ingest between 2 and 3 microg C/individual/day, demonstrating that Bosmina longirostris and Bosmina coregoni clearly differ in regulating their clearance rate in response to changes in seston food concentrations. In Dutch lakes of varying eutrophy, Bosmina coregoni replaces Bosmina longirostris, unlike many other limnological patterns of succession, because Bosmina coregoni is better adapted to waters with high food concentrations dominated by larger particles, and exploits these large particles efficiently. These results help to explain the seasonal succession in the eutrophic waters in which Bosmina coregoni invariably succeeds Bosmina longirostris as summer progresses. (Brunone-PTT)
W91-12671

MODELLING THE EUTROPHICATION OF THE SHALLOW LOOSDRECHT LAKES.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
J. H. Janse, and T. Aldenberg.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 751-757, March 1991. 7 fig, 24 ref.

Descriptors: *Eutrophication, *Limnology, *Loosdrecht Lakes, *Mathematical models, *Model studies, Aquatic organisms, Calibrations, Chlorophyll a, Cycling nutrients, Ecosystems, Eutrophic lakes, Mortality, Phosphorus, The Netherlands.

The eutrophication model PC Loos, currently being developed within the framework of the Water Quality research Loosdrecht lakes (WQL) project, is being developed to provide a tool for a better understand the lake ecosystem and predict the effects of possible or additional measures. The model is based on two main concepts: one concerning the system definition and system boundaries (the biotic and abiotic compartments and processes that determine the present state of the lake), and one concerning the closed phosphorus cycle. A number of processes in the phosphorus cycle, like mortality of organisms and settling of particles, are simply proportional to the corresponding carbon processes. The model parameters were derived from experimental work by other WQL groups, from data in the literature and calibrations on field data. Simulations were conducted using input data for Lake Loosdrecht for the years 1982 to 1987; annual external phosphorus loading was 2.01, 1.78, 1.00, 0.71, 1.24, and 1.19 mg P/sq m/day, respectively. The model predicts the sensitivity for changes in phosphorus input being larger for sestonic (and total) phosphorus than for sestonic carbon (and chlorophyll a). Both model and experimental data show that the dynamics of algal phosphorus/carbon ratios can be an important factor in the resilience of an ecosystem toward changes in phosphorus loading. Although the present model has a limited application range, the model could be adjusted for wider applications with a more thorough validation against data from other lakes, and a wider range of loadings and hydrological characteristics. (Brunone-PTT)
W91-12672

DISTRIBUTION OF THE PRODUCTIVITY OVER DIFFERENT SIZE CLASSES OF PHYTOPLANKTON IN LAKE MAARSSEVEEN I (THE NETHERLANDS). A POSSIBLE FACTOR INFLUENCING ZOOPLANKTON VERTICAL MIGRATION.
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
B. J. G. Flik, K. M. Royackers, and J. Ringelberg.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 759-762, March 1991. 4 fig, 20 ref.

Descriptors: *Animal behavior, *Lake Maarsseveen I, *Limnology, *Phytoplankton, *Primary productivity, *Vertical migration, *Zooplankton, Biomass, Chlorophyll, Epilimnion, Fish feeding, Juvenile fish, Loosdrecht Lakes, Nutrients, The Netherlands.

Phytoplankton as a food source has a determining role in the development of the size of zooplankton populations. However, phytoplankton may also influence the behavior of zooplankton, such as diel vertical migration. For reasons of phytoplankton-zooplankton interactions in the pelagic ecosystem of Lake Maarsseveen I, a study was conducted to evaluate primary production during the growth season of 1987, especially the potential production of different size classes of algal assemblage. To measure productivity, four size classes were used: 0-5 microm, 5-20 microm, 20-50 microm, and 50-150 microm. Carbon-14 incorporation was meased after 3 hours of incubation at 8 different intensities of artificial light, and for each of the size fractions, P-I curves were determined. Chlorophyll content was measured for the size classes $<$ 150 microm and $<$ 50 microm. Two vertical distributions for Daphnia hyalina were found, one in mid-June and one in early October. In June, the largest number of daphnids were situated between 8 and 9 m ($>$ 50%) and lower during daytime, while none or very few, were present between 0 and 4 m. At night, the distribution was completely different and a pronounceed migration to the surface layers took place. In October, no trace of a migration to the surface layers during night time was observed. Moreover, most daphnids were concentrated near the surface during the day, while at night the population was spread out over the top 10 m. (Brunone-PTT)
W91-12673

SEASONALITY OF PLANKTONIC DESMID SPECIES IN LAKE MAARSSEVEEN (THE NETHERLANDS) RELATED TO EXPERIMENTALLY DETERMINED GROWTH RATES IN A TEMPERATURE-LIGHT GRADIENT.
Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
P. F. M. Coesel, and H. Kooijman-Van Blokland.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 763-767, March 1991. 2 fig, 1 tab, 25 ref.

Descriptors: *Algal growth, *Desmids, *Lake Maarsseveen, *Light intensity, *Limnology, *Seasonal variation, *Water temperature, Chlorophyta, Nutrients, Periodicity, Phytoplankton, The Netherlands, Water column.

Desmid seasonality patterns observed in Lake Maarsseveen I were examined by relating growth responses to different temperatures and light intensities in culture experiments. The Maarsseveen Lakes are part of the alkaline lowland broads area, 'Vechtplassen', situated in the center of The Netherlands. Lake Maarsseveen I is mainly fed by nutrient-poor seepage from a nearby Pleistocene dune formation, and may be characterized as oligo-mesotrophic. Unialgal isolates of four species were grown in batch culture, using an apparatus that generates gradients of temperature and light intensity, and plankton from the lake were collected and analyzed twice a month. The four desmid taxa done were found to periodically exceed a population density of 10 cells/L. Optimal growth temperatures of 25 C to 30 C, found for the desmid species tested, were rather high when compared with the other phytoplankton species from temperate regions. Their growth appears principally temperature-limited, up to 15 C, and seems independent of light intensity. Therefore the late summer peak of abundance, as reported for the majority of planktonic desmid species, has to be considered a direct result of increasing temperatures. The seasonal periodicity of the planktonic species Cosmarium abbreviatum and Staurastrum cingulum in Lake Maarsseveen (I) is consistent with this general seasonal pattern. (Brunone-PTT)
W91-12674

EUTROPHICATION ABATEMENT PROGRAMME FOR THREE NORTH HOLLAND VECHT LAKES.

Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
For primary bibliographic entry see Field 5G.
W91-12675

CHANGES IN COMMUNITY STRUCTURE AND GROWTH LIMITATION OF PHYTOPLANKTON DUE TO TOP-DOWN FOOD-WEB MANIPULATION.
Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
For primary bibliographic entry see Field 5G.
W91-12676

SEASONAL AND SPATIAL VARIATION IN THE ABUNDANCE OF AQUATIC PHYTOPHILOUS MACROINVERTEBRATE FAUNA ON NUPHAR LUTEA (L.) SM. IN AN OXBOW LAKE.
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
G. van der Velde, and T. C. M. Brock.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 779-785, March 1991. 6 fig, 24 ref.

Descriptors: *Aquatic plants, *Invertebrates, *Limnology, *Macrophytes, *Oxbow lakes, *Population dynamics, *Seasonal variation, *Species composition, Aquatic animals, Leaves, Spatial distribution, Temporal distribution, The Netherlands.

Macrophytes offer large surfaces for macroinvertebrate settlement, and create microhabitats which do not exist above a macrophyte-free water bottom. In 1981, the abundance of aquatic phytophilous macroinvertebrates on the various aboveground plant parts of *Nuphar lutea* was studied in the Oude Waal, an oxbow lake of the Waal River, The Netherlands. Subsamples varying from 15 to 23 submerged or floating leaves were used to determine the mean surface area per date of the various aboveground plant parts. Five macroinvertebrate taxa appeared to be abundant, in decreasing order: Nematocera larvae, Hirudinea, Gastropoda, Oligochaeta, and Trichoptera larvae. The density of macroinvertebrates during the growth season was highest on the floating leaf petioles in nearly all cases, with an extreme peak on September 22, 1981. In June densities of macroinvertebrates on submerged leaf blades were comparable to those on the submerged leaf petioles, but in the rest of the season the densities were very low compared to those on the other plant parts. Densities on the floating leaf blades were low at the start of the growth season, but showed an enormous increase, peaking on September 22. The results indicate that the spatial and temporal distribution of the phytophilous fauna is influenced by seasonal changes in quantity and quality of aboveground plant parts, and the morphological differentiation of Nuphar lutea. (Brunone-PTT)
W91-12677

MANIPULATION OF THE THERMOCLINE IN A EUTROPHIC LAKE: THE RESPONSE OF THE ZOOPLANKTON.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
W. Hofmann, and H. J. Krambeck.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 786-790, March 1991. 6 fig, 1 tab, 5 ref.

Descriptors: *Eutrophic lakes, *Germany, *Limnology, *Plussee, *Thermocline, *Zooplankton, Aquatic habitats, Biomass, Environmental gradient, Hypolimnion, Lake morphometry, Oxygen requirements, Population density, Rotifers, Water temperature, Waterfleas.

The response of zooplankton in the Plussee, North Germany, to epilimnetic water pumped into the upper hypolimnion from April to the end of July 1986, creating a second thermocline at about 12 m was investigated in three areas: the reaction of individual populations, the influence on rotifer depth distribution, and the effect on zooplankton biomass. With respect to the response of the individual zooplankton populations to manipulation, the taxa exhibited four different reaction patterns: (1) a minor group of cladocerans did not show any significant change in vertical distribution; (2) a majority of epilimnetic rotifers and crustaceans occupied the space between the thermoclines extending their space vertically; (3) hypolimnetic taxa maintained their position below the lower thermocline, in the non-affected cold hypolimnion with very low oxygen concentrations; and (4) that some cladocerans are generally most abundant in the thermocline region. Changes in environmental gradients produced by thermal manipulation influenced the vertical organization of the zooplankton community. Throughout the experiment, most of the epilimnetic zooplankton populations occupied hypolimnetic water layers from which they were excluded under undisturbed conditions. A significant increase in zooplankton biomass emphasizes that the low mixing depth of the Pflussee limits zooplankton production because the populations are usually confined to a thin layer of the pelagic zone. The low mixing depth, low epilimnion/hypolimnion volume ratio, and long period of summer stagnation, work together, naturally, to narrow the zooplankton habitat and limit zooplankton production, and do not indicate any type of external stress on the ecosystem. (Brunone-PTT)
W91-12678

APPLICATION OF THE DROOP-MODEL OF NUTRIENT LIMITATION TO NATURAL PHYTOPLANKTON.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Oekophysiologie.
U. Sommer.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 791-794, March 1991. 2 tab, 15 ref.

Descriptors: *Algae, *Algal populations, *Limnology, *Mathematical models, *Model studies, *Nutrients, *Phytoplankton, Detritus, Germany, Growth kinetics, Phosphorus, Schohsee, Separation techniques.

Nutrient limitation of phytoplankton reproductive rates can be described by the DROOP model (in non-steady-state conditions) which relates the productive rates to the inrocellular concentration of the limiting nutrients. However, the applicability of this model is restricted by the fact the cell quota of natural populations cannot be measured easily because plankton samples usually contain a mixture of many phytoplankton species, heterotrophic organisms and detritus. A combination of size fractionation with narrower size classes, and density-gradient fractionation with narrower size classes and density-gradient fractionation was used to establish DROOP kinetics for twelve different species from the moderately eutrophic Schohsee, in northern Germany. The separation technique worked satisfactorily for species which were dominant or at least the second most important species in one size fraction. The maximal reproductive rates of eight species showed a clear dependence on physical conditions; for five species no such dependence could be found. The minimum phosphorus quotas compare favorably with literature data for freshwater plankton algae obtained from cultures. Both comparisons suggest that the values obtained here are within realistic range and justify the use of a culture derived growth model such as the DROOP model, for field populations. (Brunone-PTT)
W91-12679

DYNAMICS OF DAPHNIA MAGNA IN A SHALLOW LAKE.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Oekophysiologie.
W. Lampert.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 795-798, March 1991. 6 fig, 9 ref.

Descriptors: *Baltic Sea, *Grosser Binnensee, *Hypertrophic lakes, *Limnology, *Waterfleas, Algae, Animal physiology, Aquatic animals, Fish, Germany, Invertebrates, Population density, Predation, Species composition, Water temperature.

Grosser Binnensee, a shallow lake along the coast of the Baltic Sea, in northern Germany; the lake is hypertrophic with an algal community changed in recent years from a dominance of cyanobacteria to small green algae. Samples of the Daphnia magna population were taken twice a week with a 26 L Patalas/Schindler zooplankton trap below the surface and in 1 m depth. The size at maturation was determined and birth and death rates were calculated. Population densities remained very low until the beginning of July and increased very rapidly thereafter. Daphnia numbers exhibited three pronounced peaks that coincided with distinct clear water phases; birth and death rates do not reflect the population development. Predation pressure on Daphnia was highest in spring and early summer, and decreased in fall. The maximum sizes in Grosser Binnensee, however, increase steadily during the season and seem not to be related to temperature, which may be an indication of decreasing predation pressure during the season. Size at maturation is affected by food availability, and this effect may be responsible for the periods of extremely small sizes at maturation in Grosser Binnensee. Daphnia magna in Grosser Binnensee is probably just at the border of its potential existence in the presence of fish. Escape from predation is possible, because of the small body size at first reproduction, enhanced by high temperature and occasional low food concentrations. (Brunone-PTT)
W91-12680

SCALED CHRYSOPHYTES AS INDICATORS OF LAKE ACIDIFICATION IN WEST GERMANY.
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
H. Hartmann-Zahn.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 800-805, March 1991. 2 fig, 2 tab, 34 ref. Umweltbundesamt UFO-PLAN Nr. Wasser 10204362.

Descriptors: *Acid rain, *Acidification, *Bioindicators, *Chrysophyta, *Ecological effects, *Germany, *Lake acidification, *Limnology, *Paleolimnology, *Species composition, Conductivity, Hydrogen ion concentration, Mesotrophic lakes, Oligotrophic lakes, Water chemistry.

In order to calibrate the distribution of scaled chrysophytes against limnological conditions in central Europe, particularly pH, assemblages from 27 lake surface sediments were analyzed. This technique proved useful for paleolimnology, because the surface sediments integrate over an extended period and over the entire water column. Twenty-four of the sampled lakes are in West Germany, with one each in France, Czechoslovakia, and Austria. All of the lakes were low in conductivity, oligotrophic to mesotrophic, and part of a forested watershed some were quite rich in humic substances. Short sediment cores from the deepest point of each lake, were collected using a gravity corer, and chemical characteristics were analyzed from water samples taken during spring circulation. Forty-one chrysophyte taxa identified in the sediments, 15 of which occurred in more than five of the lakes. Results from the distribution of scaled chrysophytes in 27 surface sediments were used to reconstruct past conditions in Lake Wildsee, (a small, humic, acid lake in the northern Black Forest). Analysis of the chrysophyte assemblages, possible only in the uppermost 6 cm of the core, corresponded to sediments dating back to the 1950's, indicating an acid humic condition for the whole period. Changes in the scaled chrysophyte assemblages indicate that Lake Wildsee is suffering from acid deposition which has resulted in a decrease in dissolved organic carbon concentrations. In this instance, scaled chrysophytes were excellent indicators of present and past lake water conditions. (Brunone-PTT)
W91-12681

LIMNOCHEMICAL STUDIES AT SMALL BLACK FOREST LAKES (FRG) WITH SPECIAL EMPHASIS TO ACIDIFICATION.
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. of Zoology.
H. Thies.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 806-809, March 1991. 4 fig, 1 tab, 20 ref. Federal Environmental Protection Agency Project Water 10204342.

Descriptors: *Acid lakes, *Acid rain, *Acidification, *Black Forest, *Forest watersheds, *Limnology, Aluminum, Amphibians, Buffer capacity, Germany, Hydrogen ion concentration, Nitrates, Snowmelt, Spruce forests, Sulfates, Trace metals.

Many of the drainage basins of northern Black Forest lakes in Germany are situated on a red sandstone bedrock formation with an extremely low buffer capacity. Here, spruce forests affected by the acid rain are growing on podsolic soils. Paleolimnological analyses of lake sediment cores have shown a strong pH decline over the last 200 years. Actual acidification is detectable during snow melt, after heavy rains in inlet waters, and in the pelagic zone of the lakes, when strong pH depressions are correlated with increased NO3, SO4, and aluminum concentrations. The short retention time of the lakes has lead to high susceptibility to acid stress for both the lakes and their organisms, relative to the numerous observed acidic pulses. Severe damage to the biota have already been proven, especially to amphibians. The tendency toward meromictic behavior may somehow counteract the external input of acidifying substances. (Brunone-PTT)
W91-12682

IRREGULAR BIOMASS RESPONSE IN RECOVERING PREALPINE LAKES.
Bodensee-Wasserversorgung, Ueberlingen-Suessenmuehl (Germany, F.R.). Water Control and Research Lab.
H. H. Sabel.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 810-815, March 1991. 3 fig, 1 tab, 18 ref.

Descriptors: *Algal growth, *Biomass, *Lake Constance, *Lake Walen, *Lake Zurich, *Lake restoration, *Limnology, *Mountain lakes, *Species composition, *Trophic status, Comparison studies, Cyanophyta, Diatoms, Eutrophic lakes, Hypertrophic lakes, Mesotrophic lakes, Nutrient concentrations, Oligotrophic lakes, Phosphorus, Phytoplankton, Prealpine lakes, Switzerland.

Algal biomass was analyzed in three deep, prealpine lakes (Lake Zurich, Lake Constance, and Lake Walen) over twelve years of declining soluble reactive phosphorus (SRP). Each lake differed greatly in its biomass response to declining nutrients with respect to trophic status. Between 1979 and 1988 SRP contents measured during homeothermy declined in Lake Zurich from 84 to 58 microg/L, in Lake Constance from 88 to 50 microg/L, and in Lake Walen from 26 to 2 microg/L, while maximum concentrations were recorded in 1973 and 1975. Lake Zurich changed from hypertrophy to eutrophy, while Lake Constance shifted from eutrophy to meso-eutrophy, and Lake Walen from mesotrophy to oligotrophy. This drastic change in nutrient concentration was not reflected in a similar decrease of the annual average stock of phytoplankton biomass. During the process of oligotrophication, each lake showed tremendous oscillations within the groups of phytoplankton. From these results, three conclusions were made: (1) that only a weak trend toward declining standing stock of algal biomass during the recovery phase was noted; (2) that eutrophic-mesotrophic Lake Constance exhibited low amounts of biomass, when compared to oligotrophic Lake Walen, with no obvious explanation; and (3) during oligotrophication, competition increases for the continually decreasing phosphorus supply, resulting in an increase in bacillariophytes and a decrease in cyanobacteria. Although heavy oscillations occurred along the trend lines, triggers for blooms of cyanobacteria still remain unknown. (Brunone-PTT)
W91-12683

PARTICIPATION OF BACTERIOPLANKTON IN EPILIMNETIC PHOSPHORUS CYCLES OF LAKE CONSTANCE.
Konstanz Univ. (Germany, F.R.). Inst. fuer Seenforschung und Fischereiwesen.
H. Gude.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 816-820, March 1991. 4 fig, 1 tab, 13 ref.

Descriptors: *Bacteria, *Cycling nutrients, *Enzyme activity, *Lake Constance, *Limnology, *Phosphorus, Aquatic habitats, Biochemistry, Epilimnion, Nutrients, Seasonal variation, Water chemistry.

Bacteria represent a significant phosphorus pool in the euphotic zone of Lake Constance, Switzerland. The role of bacteria in Lake Constance was evaluated by measuring the rate of turnover of extracellular dissolved inorganic phosphorus, by determining the activity of alkaline phosphatases, by estimating the bacterial phosphorus pool, and by observing the phosphorus uptake into different size fractions of epilimnetic waters. Lowest turnover times were observed during summer. When more than 50% of the particulate phosphorus and almost 40% of the total phosphorus, were found in the <1 microm size fraction. Similarly, 50 to 90% of the 32-P phosphate uptake occurred in the bacterial size fraction. These data, together with a consideration of the high carbon:phosphorus ratios of dissolved organic substrates, suggest that bacteria function mainly as phosphorus sinks during epilimnetic summer phosphorus depletion. (Brunone-PTT)
W91-12684

SEASONAL AND INTERANNUAL VARIATION OF AUTOTROPHIC PICOPLANKTON IN A LARGE PREALPINE LAKE (LAKE CONSTANCE).
Konstanz Univ. (Germany, F.R.). Limnological Inst.
T. Weisse, and A. Schweizer.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 821-825, March 1991. 3 fig, 1 tab, 16 ref. Stiftung Volkswagenwerk Grant I/63699.

Descriptors: *Biomass, *Lake Constance, *Limnology, *Phytoplankton, *Picoplankton, *Seasonal variation, Ciliates, Crustaceans, Mountain lakes, Population dynamics, Prealpine lakes, Productivity, Rotifers, Switzerland, Vertical distribution, Weather, Zooplankton.

Autotrophic picoplankton is an important component of the phytoplankton assemblage in Lake Constance. Samples were taken in weekly to monthly intervals with a 2 m long sampling tube, from surface to 20 m water depth. Cell numbers, biomass, and production show a pronounced vertical, seasonal and yearly variation. Interannual variation was mainly attributable to differences in weather conditions. Irrespective of these weather conditions, however, the population development of autotrophic picoplankton follows a recurrent seasonal pattern, with the highest abundance occuring in near-surface waters in spring and late summer. During the clear-water phase, autotrophic picoplankton concentrations were drastically diminished by excessive zooplankton grazing, mainly of rotifers. Ciliates were temporarily important consumers of autotrophic picoplankton production, while the impact of larger crustacean zooplankton was generally low. Autotrophic picoplankton production was found to vary between 1 to 10 mg m/hr. (Brunone-PTT)
W91-12685

LONG TERM DEVELOPMENT OF PHYTOPLANKTON IN LAKE CONSTANCE.
Landesanstalt fuer Umweltschutz Baden-Wuerttemberg, Karlsruhe (Germany, F.R.). Inst. fuer Seenforschungs Fischereiwesen.
R. E. Kummerlin.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 826-830, March 1991. 4 fig, 1 tab, 16 ref.

Descriptors: *Algae, *Eutrophic lakes, *Eutrophication, *Lake Constance, *Limnology, *Phytoplankton, Algal populations, Catchment areas, Cryptophyta, Ecological effects, Oligotrophic lakes, Seasonal variation, Species composition, Succession, Switzerland.

With accelerating eutrophication occurring in Lake Constance, Switzerland the International Commission for the Protection of Lake Constance was founded to develop and take measures for the protection and sanitation of the lake. Water samples were taken, and phytoplankton were counted, indicating that with the accelerating eutrophication in the 1960's and 1970's, algal biomass has increased. Declines in phosphorus concentrations due to sanitation measures in the catchment area have caused no significant decrease of phytoplankton biomass. With increasing lake eutrophication in the 1960's, the phytoplankton community structure changed significantly, although Chlorophyceae increased strongly at the beginning of the main eutrophication period, recent oligotrophication did not result in a decrease in the mean phytoplankton biomass. Changes have occurred however, in the phytoplankton community and in patterns of seasonal succession. The reversal to a more oligotrophic state in Lake Constance has been indicated by a shift in the occurrence of Asterionella formosa toward the spring bloom, the reappearance of Cyclotella species, the comeback of Tabellaria fenestrata in summer, and the reobservation of cryptophycean species such as Cryptaulax vulgaris. (Brunone-PTT)
W91-12686

RELATIONS AMONG THE COMPONENTS OF AUTOTROPHIC AND HETEROTROPHIC PLANKTON DURING THE SEASONAL CYCLE 1987 IN LAKE CONSTANCE.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
W. Geller, R. Berberovic, U. Gaedke, H. Muller, and H. R. Pauli.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 831-836, March 1991. 1 fig, 1 tab, 26 ref. Deutsche Forschungsgemeinschaft Special Research Program SFB248.

Descriptors: *Algae, *Bacteria, *Lake Constance, *Limnology, *Mountain lakes, *Oligotrophic lakes, *Phytoplankton, *Plankton, *Seasonal variation, *Zooplankton, Biomass, Prealpine lakes, Productivity, Species composition, Standing crops, Switzerland.

Particular plankton groups in Lake Constance, Switzerland, were investigated to evaluate biomass and production relationships. The Uberlingersee, the fjordlike northwestern bight of Lake Constance which appears to be the most oligotrophic part of this meso-eutrophic, warm-monomictic, prealpine lake, was sampled in weekly intervals during the growing season, but in longer intervals during the winter. Analysis of the first complete annual cycle of plankton revealed that: (1) the overall standing crop of plankton was surprisingly constant throughout the growing season although the individual components exhibited pronounced variation; (2) the microzooplankton dominated the zooplankton community in terms of productivity during most phases of the season, reaching up to three quarters of the total productivity of zooplankton and 48% on annual average, reflecting the importance of microzooplankton within the planktonic system of the lake; and (3) excluding the periods of build-up (spring) and breakdown (fall) of the planktonic system, the pools of small, fast growing and of large, slow growing phytoplankton, and consumers of bacteria, covary. Therefore, during the course of a year, the ratio between the pool size system and the total flow

rate of matter through the pool, results in a near-constant turnover time of four days, irrespective of changing community composition and different levels of biomass. (Brunone-PTT)
W91-12687

PHOSPHORUS AND CARBON VALUES OF ZOOPLANKTON SPECIES IN LAKE CONSTANCE.
Konstanz Univ. (Germany, F.R.). Inst. fuer Seenforschung und Fischereiwesen.
H. B. Stich.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 837-841, March 1991. 4 fig, 2 tab, 13 ref. Deutsch Forschunsgemeinschaft Collaborative Research Program SFB248.

Descriptors: *Dissolved organic carbon, *Lake Constance, *Limnology, *Nutrients, *Phosphorus, *Zooplankton, Carbon, Copepods, Cycling nutrients, Diurnal variation, Rotifers, Seasonal variation, Switzerland.

From April until October 1988 samples were taken twice a month, from the main basin (Obersee) of Lake Constance, Switzerland, to quantify the pool size of the carbon and phosphorus contents of zooplankton species, C/P ratios, and particulate phosphorus. In rotifers, the lowest carbon and phosphorus values were found for Polyarthra sp. and highest values for colonies of Conochilus unicornis with Chlamydomonas gloeophila incorporated in their gelatinous sheath. In copepods, minimum values were observed for copepodites of Mesocyclops leuckartii and maximum values for ovigerous females of Cyclops abyssorum. Intercepts and slopes of the linear carbon-phosphorus regressions differed significantly for these taxonomic groups. Seasonal changes of carbon and phosphorus values coincided only in large animals, while in medium and small animals, no coincidence was apparent. Based on several simplifying assumptions, estimated phosphorus pools of zooplankton were approximated. However, these approximations are likely to represent only minimum estimates because the whole zooplankton community was not included. By applying phosphorus values to changing distributions of Daphnia in the upper 10 m in June 1977, particulate phosphorus values were obtained, and ranged between 0.33 microg/L and 3.58 microg/L at noon, and 2.31 to 8.3 microg/L at midnight. Including bacteria, particulate phosphorus of zooplankton and bacteria ranged from 7% and 69% of the estimated total particulate phosphorus. Phosphorus recycling by direct and indirect impacts of zooplankton on concurrent plankton communities may cause at least temporally sufficient phosphorus source in Lake Constance. (Brunone-PTT)
W91-12688

ZOOPLANKTON GRAZING IN LAKE CONSTANCE: SEASONAL AND DAY-NIGHT IN SITU MEASUREMENTS.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
R. M. Pinto-Coelho.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 842-845, March 1991. 3 fig, 1 tab, 12 ref. Brazilian Education Ministry Grant No. MEC/CAPES Proc: 386/86-2.

Descriptors: *Animal behavior, *Diurnal variation, *Lake Constance, *Limnology, *Seasonal variation, *Stratification, *Zooplankton, Copepods, Migration, Periodicity, Rotifers, Species composition, Switzerland, Turbidity, Water temperature, Waterfleas.

Since November 1987, the grazing activities in Lake Constance, Switzerland, have been routinely monitored, with special attention paid to the daily rhythms of food uptake and the contribution of smaller organisms to the overall grazing pattern. The typical summer stratification occurs with surface temperatures reaching 23 C, between periods of thermal instability to the water column. In June 1988, a pronounced clear water phase occurred with Secchi depth measurements registering 18 m. The highest community grazing rates (CGR) occurred before and after this clear-water phase. The CGR's measured in Lake Constance in the daytime were comparable to those from other temperate lakes, with CGR night values as high as 1000 ml/L/day in the upper 10 m. The diel rhythms found in individual filtering rates of vertically migrating species, may be an effect from temperature. The often neglected size fraction containing small herbivores, like rotifers and nauplii, may also have a significant role in the overall grazing intensity, especially when daphnids are less abundant in the lake. (Brunone-PTT)
W91-12689

PELAGIC CILIATES IN LAKE CONSTANCE: COMPARISON OF EPILIMNION AND HYPOLIMNION.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
H. Muller, W. Geller, and A. Schone.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 846-849, March 1991. 3 fig, 1 tab, 10 ref. Deutsche Forschungsgemeinschaft Special Collaboration Program (SFB)248.

Descriptors: *Ciliates, *Epilimnion, *Hypolimnion, *Lake Constance, *Limnology, *Seasonal variation, Biomass, Nutrient concentrations, Plankton, Population dynamics, Species composition, Switzerland, Water depth.

The seasonal dynamics of ciliate communities were explored in the epilimnion and hypolimnion of deep meso-eutrophic Lake Constance, Switzerland. Ciliates were collected with a 2 m tube sampler at the site of maximum depth in the northwestern part of Lake Constance, from February 1987 through December 1988 in weekly to biweekly intervals. Annual mean values and ranges of ciliate abundance and biomass decreased with depth. Fifty to sixty percent of the total ciliate biomass/sq m were concentrated in the uppermost 20 m. Averaged over the year, cell numbers in the epilimnion were markedly larger than in the hypolimnion. Two maxima were recorded: in April, and in July to August. Availability of appropriate food was a major factor determining ciliate composition at different depths. The community structure of ciliates in Lake Constance seems unique in the striking predominance of Prostomatida. The ratio of nanoplankton to picoplankton consumed by ciliates in Lake Constance decreases with depth. Predominantly algivorous ciliates in the epilimnion and increasingly more bacterivorous ciliate species in the deeper water might be characteristic for deep lakes with aerobic hypolimnions. (Brunone-PTT)
W91-12690

ESTIMATES OF ROTIFER PRODUCTIVITY IN LAKE CONSTANCE: A COMPARISON OF METHODS.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
H. R. Pauli.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 850-853, March 1991. 4 tab, 24 ref.

Descriptors: *Biomass, *Lake Constance, *Limnology, *Mathematical models, *Model studies, *Primary productivity, *Rotifers, Comparison studies, Data interpretation, Estimating, Growth rates, Population dynamics, Switzerland.

Four different methods, using two different data sets, have been compared for the estimation of rotifer productivity in Lake Constance, Switzerland: (1) summation of positive biomass differences of consecutive sampling days; (2) the turnover of numbers using the birth rate as an estimate for a turnover rate; (3) a modified growth increment summation method using one weight increment from zero to adult biomass; and (4) the growth increment summation method with two weight increments, from zero to egg weight and from egg to adult body weight. The estimates ranged from 6.5 g DW/sq m to 16.3 g DW/sq m and 2.3 g DW/sq m to 4.4 g DW/sq m in 1984 and 1985, respectively. Method 1, which always generated the lowest estimates, clearly underestimates the true productivity, because only new production is measured. This method is very sensitive to random fluctuations. Method 2 generated higher estimates from the data set of interpolated data. Method 3 gis based on the assumption that accumulation of biomass after hatching is negligible, while method 4 attempts to correct the estimates of method 3. Method 4 appears to overestimate productivity because post-embryonic development was never properly measured. The relative importance of rotifer biomass was 19.1% and 13.6% of Daphnia mean biomass, and to 25.8% and 22.5% of Daphnia productivity in 1984 and 1985. In long-term averages of primary productivity, the rotifers contributed 3.1% of primary productivity, and Daphnia 37.3% productivity, appearing even more important than in the two years 1984 and 1985. (Brunone-PTT)
W91-12691

PELAGIC COPEPOD SPECIES IN LAKE CONSTANCE: ABUNDANCE, BIOMASS, AND SECONDARY PRODUCTIVITY.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
S. Wolfl.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 854-857, March 1991. 3 fig, 1 tab, 28 ref.

Descriptors: *Biomass, *Copepods, *Lake Constance, *Limnology, *Secondary productivity, *Zooplankton, Consumption, Ecosystems, Food chains, Rotifers, Seasonal variation, Switzerland, Waterfleas.

The annual course of abundance and biomass of the most important copepods in Lake Constance, Switzerland, was determined in order to estimate their role within the ecosystem network of energy flow. Zooplankton samples were collected weekly, from April to October, and biweekly from November to March. Copepods were abundant during spring and autumn, amounting to considerable standing stocks of biomass and daily secondary production rates. However, the turnover rates of copepods was small compared to other zooplankton groups. Daphnia and rotifers showed higher productivity/biomass coefficients in previous years. Assuming a gross growth efficiency productivity/consumption of 40%, the consumption of copepods was estimated to 21 g C/sq m/year, which calculated out to 10% of the annual primary production. This reflected their small trophic importance within the carbon flux from primary producers to secondary producers, although their contribution to the total standing stock of heterotrophs was probably high during the growing season and in winter. (Brunone-PTT)
W91-12692

COMMUNITY GRAZING IN LAKES OF DIFFERENT TROPHIC STATES.
Munich Univ. (Germany, F.R.). Zoologisches Inst.
J. Platzek.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 858-861, March 1991. 3 fig, 1 tab, 17 ref.

Descriptors: *Algae, *Brunnsee, *Crustaceans, *Food chains, *Limnology, *Phytoplankton, *Primary productivity, *Thalersee, *Trophic status, Biomass, Diatoms, Eutrophic lakes, Germany, Productivity, Water sampling, Waterfleas, Zooplankton.

The impact of crustacean plankton on the whole phytoplankton community was investigated in two lakes in Germany, with different trophic levels, and to determine the role of grazing in the utilization of phytoplankton primary production. Water samples were collected from the oxic water column by an electric pump and tube, filtered through 160 microm mesh net to exclude crustacean zooplankton, mixed in a 200 L barrel and

filled into 10 L plexiglass containers. Subsamples were taken for the determination of phytoplankton and zooplankton was gathered by vertical hauls. In Lake Brunnsee, the phytoplankton biomass showsed nearly constant values of 2 mg Chl a/cu m, indicating the mesotrophic character of the lake. Phytoplankton consists mainly of centric diatoms, which can be readily grazed by zooplankton. In Lake Thalersee, phytoplankton biomass is 20 to 80 times higher than value in Brunnsee, and the community is dominated by large colonies or filaments; the crustacean community consists mainly of small cladocerans. In both lakes 50 to 60% of the gross primary production (GPP) is quickly lost in metabolic processes. Relative losses due to sedimentation in both lakes are 20 to 30% GPP. In mesotrophic Brunnsee about 25% of the GPP is used by crustaceans; in eutrophic Thalersee, crustacean consumption seems nearly negligible, reaching only 5% of GPP. Grazing of zooplankton < 160 microm on phytoplankton was probably unimportant, as the dark controls showed no significant decrease in chlorophyll a content. A further possibility could be the existence of additional carbon losses not measured in these experiments. (Brunone-PTT)
W91-12693

LOCAL DIFFERENCES IN THE VERTICAL DISTRIBUTION OF THE BENTHOS IN THE PREALPINE LAKE CHIEMSEE.

Zoologische Staatssammlung Muenchen (Germany, F.R.).
C. Orendt.

Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 862-865, March 1991. 1 fig, 1 tab, 5 ref.

Descriptors: *Benthos, *Chiemsee, *Distribution patterns, *Limnology, Aiterbacher Bay, Aquatic organisms, Eutrophic lakes, Germany, Kailbacher Bay, Littoral zone, Mesotrophic lakes, Population density, Statistical analysis.

From June to December 1987, the vertical distribution of benthic fauna in the highly structured Lake Chiemsee, Germany, was qualitatively and quantitatively investigated, using sediment samples taken with a van Veen grab at three transects. Larvae were identified, counted and measured. Seventy-four taxa were found in these samples. The maximum values of individual population density were found in littoral sediments of the eutrophic Aiterbacher Bay, with 12,000 individuals/sq m; minimum values were found in the profundal region of Kailbacher Bay, with 200 individuals/sq m. Cluster analysis showed three groups of habitats: all littoral localities, profundal and sublittoral localities, and the profundal locality of the Aiterbacher Bay. The average size of larvae at the different sites was negatively correlated with the average individual density ($r = -0.696$, $p < 0.001$). Chaoborus flavicans and tubificid worms were sampled and evaluated quantitatively to supply estimates of nutrient load. According to these trophic level indicator organisms, the Aiterbacher Bay was strongly eutrophic, the Kailbacher Bay was weakly eutrophic, and a site to the south of Gstadt was mesotrophic to weakly mesotrophic. In the strongly eutrophic part of the lake, uniform profundal communities were found even at shallow depths, although these were possibly of a temporary nature. (Brunone-PTT)
W91-12694

LONG-TERM CHANGES OF CRUSTACEAN PLANKTON DURING SUCCESSFUL RESTORATION OF LAKE SCHLACHTENSEE (BERLIN-WEST).

Bundesgesundheitsamt, Berlin (Germany, F.R.).
Inst. fuer Wasser-, Boden- und Lufthygiene.

For primary bibliographic entry see Field 5G.
W91-12695

NUTRIENT BALANCES AND PHYTOPLANKTON DYNAMICS IN SCHLACHTENSEE DURING OLIGOTROPHICATION.

Bundesgesundheitsamt, Berlin (Germany, F.R.).
Inst. fuer Wasser-, Boden- und Lufthygiene.
G. Klein, and I. Chorus.

Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 873-878, March 1991. 5 fig, 12 ref.

Descriptors: *Algae, *Limnology, *Nutrients, *Oligotrophy, *Phytoplankton, *Population density, *Schlachtensee, Biomass, Epilimnion, Germany, Lake Tegel, Lake restoration, Oxygen requirements, Phosphorus, Photosynthesis, Seasonal variation, Transparency, Wannsee.

Lake Schlachtensee is being restored by treating its main inflow via phosphate precipitation and subsequent filtration. As a result, the phosphate content of the lake has been reduced very quickly--the total phosphorus influx flowing from Wannsee into Schlactensee decreased from about 1500 kg/year (1980 to 1981) to about 30 kg/year since 1986. The annual mean value of the total phosphorus concentration is currently about 0.03 mg/L phosphorus, only a bit over the goal of 0.02 mg/L phosphorus. Exchange activities at the thermocline have been reduced from about 100 mg/sq m/day to only a few mg/sq m/day within two years of the start of the phosphate removal. The temporal and spatial extension of anaerobic conditions was reduced due to a reduction of phytoplankton settling rates and a lower phytoplankton biomass. During summer from 1980 to 1983, inorganic nitrogen was nearly completely removed from the epilimnion, and ammonia accumulated in the hypolimnion and in 1988, nitrate concentrations ranged between 0.5 and 1.8 mg/L in the epilimnion. Studies at Lake Tegel during summer stagnation in 1989 showed a stronger oxygen consumption in the lower epilimnion and the upper hypolimnion, than near the sediment water layer, confirming the calculations at Lake Schlachtensee. Most actual oxygen consumption in spring and summer was due to a rapid decomposition of fresh organic matter, detritus and algal cells after these materials fell below the euphotic zone. The highest biovolume integrals after the switch in species composition were observed during the winter and early spring of 1988, when physical factors enhanced the growth of pennate diatoms. Phytoplankton biomass is not lower than before the restoration began, and water transparency is much higher. A reduction in the phosphate concentrations caused the disappearance of Oscillatoria agardhii. Because of an increase in euphotic depth, maxima of integral photosynthesis still reached the same level as in 1982/1983, but situations with low integrals have become more frequent due to low biomass densities limiting photosynthesis. Annual production decreased from 1570 g/sq m oxygen in 1982 to 1010 g/sq m oxygen. (Brunone-PTT)
W91-12696

SPRING CLEAR-WATER PHASE IN A EUTROPHIC LAKE: CONTROL BY HERBIVOROUS ZOOPLANKTON ENHANCED BY GRAZING ON COMPONENTS OF THE MICROBIAL WEB.

Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
H. Arndt, and B. Nixdorf.

Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 879-883, March 1991. 3 fig, 24 ref.

Descriptors: *Eutrophic lakes, *Food chains, *Grazing, *Limnology, *Muggelsee, *Zooplankton, Biomass, Diatoms, Ecosystems, Food habits, Germany, Microbiological studies, Phytoplankton, Protozoa, Transparency.

Metazooplankters are known as important regulators of the density and composition of phytoplankton in lakes. In Lake Muggelsee (Berlin), Germany, an apparent minimum of microbial components occurs at the time of peak metazooplankter biomass in early summer. A similar phenomenon has also been reported from some other ecosystems. This gave rise to an investigation on the direct grazing impact of metazoans on microbial components as important nutrient remineralizers. According to preliminary results, the mesozooplankton at its highest densities in early summer may not only have a direct effect on phytoplankton via grazing. Including microbial activities, the succession of planktonic events may be characterized as follows: In early summer, the spring phytoplankton community with relatively low grazing pressure and high nutrient recycling, changes to an intensively grazed phytoplankton community with grazed components of microbial recycling. Through this, nutrient deficiency in the water column should increase. Then, in summer, a phytoplankton community establishes under moderate grazing pressure, accompanied by intensive microbial recycling. During winter and spring, protozoans seem to be the most important zooplankton component. During this time, not only ciliates but also large heterotrophic flagellates may contribute significantly to phytoplankton mortality; these large flagellates have been overlooked in limnological research. In Lake Muggelsee, their biomass was as high as that of nanoflagellates, and it was found that they often consumed algae of the 'non-edible' fraction of phytoplankton. (Brunone-PTT)
W91-12697

CONTRIBUTION OF DINITROGEN FIXATION AND DENITRIFICATION TO THE N-BUDGET OF A SHALLOW LAKE.

Humboldt-Univ. zu Berlin (German D.R.). Sektion Biologie.
G. Dudel, and J. G. Kohl.

Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 884-888, March 1991. 2 fig, 2 tab, 28 ref.

Descriptors: *Denitrification, *Grosser Muggelsee, *Limnology, *Nitrogen cycle, *Nitrogen fixation, *Nutrients, Anaerobic conditions, Biomass, Cyanophyta, Depth profile, Germany, Phosphates, Sediment chemistry, Spree River.

The nitrogen budget for Lake Grosser Muggelsee, Germany, a highly loaded shallow lake, was measured in a seven-year study at weekly or fortnightly intervals, to estimate the contribution of dinitrogen fixation and denitrification. Samples were taken at the inflow and outflow of Spree River and near the deepest point for a depth profile. The area-related nitrogen input by cyanobacteria was calculated from water volume and biomass related acetylene reduction rates, and was found to be negligible. Nitrogen fluxes were calculated on the basis of mean weekly mass flow/sq m lake area and input by dinitrogen fixation of cyanobacteria was found to be relatively small. However, nitrogen fixation partially compensates for the losses of the pelagic system, and completely fulfilled the nitrogen requirement of the dominant nitrogen-fixing population. The calculated denitrification rates suggest that a significant part of the nitrate load is eliminated. However, the maximum dinitrogen input by cyanobacteria is related to the seasonal nitrate minimum with low, nitrate-limited, denitrification rates. Further knowledge is needed about nitrate depletion, and the multiple causes of mass development of nitrogen-fixing cyanobacteria connected with anaerobic sediments and phosphate remobilization, even in shallow lakes. (Brunone-PTT)
W91-12698

COMPETITION EXPERIMENTS WITH TWO PLANKTIC BLUE-GREEN ALGAE (OSCILLATORIACEAE).

Humboldt-Univ. zu Berlin (German D.R.). Sektion Biologie.
A. Nicklisch, B. Roloff, and A. Ratsch.

Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 889-892, March 1991. 4 fig, 2 tab, 16 ref.

Descriptors: *Algae, *Algal growth, *Competition, *Cyanophyta, *Eutrophic lakes, *Limnology, *Phytoplankton, *Polytrophic lakes, *Population dynamics, *Succession, Daylength, Light intensity, Limiting nutrients, Nitrogen, Phosphorus, Water temperature.

The cause of cyanobacterial succession in some eutrophic to polytrophic lakes is unknown, since

the specific growth rate of Limnothrix redekei is higher than that of Oscillatoria agardhii under different conditions of temperature, light intensity, daylength, phosphorus and nitrogen supplies. Competition experiments were carried out in semi-continuous culture with these two blue-green algal species. The biomass of Limnothrix redekei increases and that of Oscillatoria agardhii decreases under conditions of nutrient and light saturation. Under phosphate limitation, L. redekei is clearly the stronger competitor at different daylengths. O. agardhii ceases its growth and is washed out. Under nitrogen limitation both species can co-exist over six weeks at different daylengths. The time interval between dilutions has a slight influence on competition. The results of growth kinetics and competition of L. redekei and O. agardhii, however, cannot explain the succession of mass populations of L. redekei and O. agardhii as observed in late spring or summer in some lakes. Usually this succession is connected with rising temperatures, long photoperiod, high biomass of phytoplankton, ceasing phosphorus-limitation and beginning nitrogen-limitation, but all these abiotic factors can only favor a dominance of L. redekei or the coexistence of both species. This approach may explain the cause of species succession observed in some eutrophic lakes. (Brunone-PTT)
W91-12699

ESTIMATION OF PHYTOPLANKTON PRODUCTION AND LOSS PROCESSES IN A EUTROPHIC SHALLOW LAKE.
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
For primary bibliographic entry see Field 5C.
W91-12700

INFLUENCE OF RESUSPENSION ON SEDIMENT OXYGEN DEMAND (SOD) IN THE LAKES OF DIFFERENT MORPHOLOGY AND TROPHY.
Nicholas Copernicus Univ. of Torun (Poland). Inst. of Biology.
For primary bibliographic entry see Field 5B.
W91-12701

REACTION OF PHYTOPLANKTON COMMUNITY ON HYPOLIMNIC AERATION.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W91-12702

PHYTOPLANKTON OF EUTROPHIC LAKES IN WESTERN POLAND.
Institute of Physical Planning and Municipal Economy, Poznan (Poland).
For primary bibliographic entry see Field 5C.
W91-12703

EUTROPHICATION AND STRESS IN PHYSICALLY STABLE AND UNSTABLE LAKES: EFFECTS ON PHYTOPLANKTON STRUCTURE AND SEASONALITY.
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
For primary bibliographic entry see Field 5C.
W91-12704

ROLE OF BENTHIC BIOTA IN THE PHOSPHORUS FLUX THROUGH THE SEDIMENT-WATER INTERFACE.
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
R. J. Wisniewski.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 913-916, March 1991. 4 fig, 2 tab, 9 ref.

Descriptors: *Cycling nutrients, *Limnology, *Microorganisms, *Phosphorus, *Sediment-water interfaces, *Zoobenthos, Aerobic conditions, Anaerobic conditions, Antibiotics, Bacteria, Dissolved oxygen, Invertebrates, Path of pollutants, Poland, Population density, Sediment chemistry, Sediment contamination.

The role of abiotic factors and microbial and zoobenthos activity were investigated in the exchange of soluble reactive phosphorus (SRP) between the sediments and overlying water in Polish lakes. Short-term laboratory experiments were carried out using intact sediment cores plus their overlying water collected from four Polish lakes differing in the chemical properties of their sediments. The total amount of SRP in the cores was estimated as the sum of the SRP in the interstitial water in a 15 cm thick layer of sediment and the SRP in a 20 cm high column of overlying water. The addition of antibiotic caused a decrease in the number of active bacteria in the sediments and in the near-bottom layer by 4 and 3 to 4 orders of magnitude, respectively. Invertebrate density was not affected by the antibiotic. The oxygen concentration in the aerated cores reached 50 to 80% saturation at the sediment surface. To assess the role of abiotic factors, the following assumptions were made: changes in SRP content in the cores poisoned by formalin were caused by abiotic factors; the differences between the untreated and antibiotic treated cores was due to microbial activity; differences between the cores treated with antibiotic and formalin were due to zoobenthos; and because temperature was constant and oxygen concentration was a treatment, the only abiotic factors affecting SRP flux were sediment structure and chemical composition. In cores from all four lakes, changes in SRP were noted in both interstitial and near-bottom water. When the sediment-water interface was oxidized, abiotic factors caused a decrease of SRP while microbial activity in most cases and zoobenthos activity in all cases caused an increase in SRP. Under reducing conditions abiotic factors increased the release of SRP from the sediment; when the sediment-water interface was oxidized, abiotic factors had the opposite effect. In contrast to the SRP content in the whole experimental system the exchange of SRP between sediment and water in those lakes studied was controlled mainly by abiotic factors and zoobenthos activity. (Brunone-PTT)
W91-12705

COMPETITIVE INTERACTIONS BETWEEN CLADOCERANS AND ROTIFERS: AN EXPERIMENTAL STUDY.
Warsaw Univ. (Poland). Dept. of Hydrobiology.
P. Dawidowicz, and J. Pijanowska.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 917-920, March 1991. 6 fig, 12 ref. Governmental grant CPBP 04.10.08.

Descriptors: *Competition, *Lake Ros, *Limiting nutrients, *Limnology, *Organic carbon, *Poland, *Population dynamics, *Rotifers, *Waterfleas, Estimating, Nutrients.

The temporal daily changes of the rotifer abundance were followed in in situ enclosures, which also contained desired, low or high cladoceran densities. The experiment was located on the inshore of the meso-eutrophic Lake Ros, Poland. The level of resources available to herbivorous cladocerans and rotifers was measured as a particulate organic carbon concentration in the fraction of seston particles smaller than 50 microm. The obtained values were overestimated for rotifers which feed preferentially on the particles in the 1 to 20 microm size range. The initially low cladoceran density increased exponentially in both experimental sets, from 0 to 45 individuals/L in filtered water and from 2.5 to about 50 individuals/L in unfiltered lake water. In unfiltered water, this increase was accompanied by a simultaneous drastic decrease in rotifers, from 450 to 20 individuals/L. In filtered water, constant increase in rotifer density was observed for the first 11 days, from 75 to 375 individuals/L, and then the density decreased to reach about 20 individuals/day. The apparent cause for the suppression of rotifers by the big cladocerans in the experimental enclosures was the sedimentation of the seston particles, rather than exploitation by grazing animals, since the number of cladocerans was still low. Both number and relative abundance of rotifers similarly decreased in the filtered water under the weak invertebrate pressure, and in the natural lake water under much stronger invertebrate predation. The interference competition between large cladocerans and rotifers should most probably be blamed for the suppression of the rotifers. (Brunone-PTT)
W91-12706

ECOSYSTEMS AND BIOCOENOSES OF ZOOBENTHOS OF THE DEEP LAKES OF THE BALTIC HILLY-MORAINIC UPLAND.
Akademiya Nauk Litovskoi SSR, Vilnius. Inst. of Ecology.
A. Grigelis.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 921-923, March 1991. 17 ref.

Descriptors: *Crustaceans, *Ecosystems, *Lake sediments, *Limnology, *Lithuania, *Species composition, *Species diversity, *Thermal stratification, *Water depth, Biomass, Deep water, Dissolved oxygen, Hypolimnion, Metalimnion, Midges, Transparency.

The lakes of Lithuania are divided into four groups: (1) very deep and stratified, (2) deep and stratified, (3) deep and medium-stratified, and (4) shallow and stratified. The epilimnion layer in most lakes of Lithuania was 6 to 10 m, in some lakes was 15 to 18 m, and in several lakes only 1 m. The metalimnion fluctuates from 2 up to 10 m. The hypolimnion can be found in the thermally stratified very deep and deep lakes. The lakes are of different origins: glacial, river, sea, karst, artificial. The Secchi transparency of water fluctuated from 0.25 up to 9.2 m. The maximum temperatures in the upper layers of water occur in the middle or at the end of July. The highest temperature of water was 26 C. The benthic fauna of the cold water zones is not rich and shows different indices of weight and size. Distribution of benthic animals in the Lithuanian lakes depends not only on temperature of water but also on the concentration of dissolved oxygen near the bottom. The diversity of benthic fauna of deep zones is increased by glacial relict Crustacea. The most frequent larvae of Chironomidae in the profundal zones are Chironomus anthracinus and Sergentia longiventris. Lakes of the national park of Lithuania are subdivided on the basis of an index of density and biomass into four groups: (1) lakes in which Chironomidae were the most important group constituting from 50.0 to 83.3% of the abundance and from 56.8 to 94.3% of the biomass; (2) lakes in which the Chironomidae were the second most important group constituting from 31.5 to 50.0% of the abundance and from 23.7 to 45.7% of the biomass; (3) lakes in which the Chironomidae were the second or third most important group constituting from 12.0 to 19.0% of the abundance and from 14.3 to 21.4% of the biomass; and (4) lakes in which the Chironomidae were the third most important group constituting from 0.0 to 6.8% of the abundance and from 0.0 to 10.0% of the biomass Structure of biocenoses of stratified deep lakes is different and depends on the sediments. (Brunone-PTT)
W91-12707

COMPARATIVE GRAZING ACTIVITIES OF THE ROTIFER AND CRUSTACEAN COMMUNITIES IN A EUTROPHIC LAKE.
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. d'Hydrobiologie.
N. Lair.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 924-927, March 1991. 5 fig, 15 ref.

Descriptors: *Crustaceans, *Eutrophic lakes, *Feeding rates, *Lake Aydat, *Rotifers, Algal physiology, Bacteria, Biomass, Comparison studies, France, Mathematical models, Model studies, Nutrients, Population density, Population dynamics, Turnover time.

A study was conducted in Lake Aydat, France, to compare the grazing activities of zooplankton communities to determine the impact of rotifers and crustaceans, respectively, from the time of the spring algal bloom to the end of summer and to

obtain data for models of causal relationships for the loss of phytoplankton and gazing. Rotifera contribute significantly to zooplankton biomass and productivity in a wide variety of lakes. The intense grazing activity of these organisms can be an important factor influencing nanoplankton and bacteria. The highest community grazing rate was observed at the beginning of July (> 100%), principally due to rotifer activity. Despite the assimilation efficiency, in Lake Aydat, the rotifer community could play the most important role of the zooplankton community. In Lake Aydat, the rotifer community can regulate algal and bacterial communities. The large grazing rates of the three rotifer populations, which consume small-sized prey, can partly explain the low density of small algae in the eutrophic lake. The minimum measured grazing rate seems to be linked to the turnover time of bacteria rather than of algae. Mean filtering rates cannot be a useful tool for models simulating phytoplankton population dynamics in Lake Aydat, since growth rates are dependent on nutrient limitation, mixing and herbivore grazing. Phytoplankton density affects the functional grazing response of herbivores. (Brunone-PTT)
W91-12708

WHAT IS THE BEST TIME REFERENCE TO EXPRESS BIOLOGICAL RESULTS: THE CALENDAR YEAR OR THE ECOLOGICAL YEAR.
Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Inst. de Limonologie.
G. Balvay.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 928-930, March 1991. 3 fig, 1 tab, 6 ref.

Descriptors: *Climatic changes, *Data acquisition, *Experimental design, *Limnology, *Sampling, *Seasonal variation, Annual variation, Timing.

Data collected in Lake Geneva, from 1959 through 1988 were examined in an effort to determine whether calendar year or ecological year is the most appropriate time frame for reporting the results of biological studies. The date of minimum water temperature was selected as the start of the ecological year. In many cases the ecological year is highly variable, as compared to the calendar year. Physical, chemical and biological cycles exhibit important year-to-year variations which are related to annual differences in seasonal changes in local climatic conditions. These variations, when appearing in fall and sometimes lasting until late winter, are included in the calendar year 1987, despite the fact that they belong to the previous ecological year '1986-1987' or to the actual one, '1987-1988'. The ecological year permits precise correlation of year-to-year biological changes and concomitant changes in other abiotic and biotic parameters. (Brunone-PTT)
W91-12709

PLANKTON SUCCESSION IN LAKE SEMPACH, LAKE HALLWIL AND LAKE BALDEGG BEFORE AND DURING INTERNAL RESTORATION MEASURES.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5G.
W91-12710

BODYMASS OF CRUSTACEAN PLANKTON IN LAKE BIEL: A COMPARISON BETWEEN PELAGIC AND LITTORAL COMMUNITIES.
Bern Univ. (Switzerland). Zoologisches Inst.
T. Vuille, and V. Maurer.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 938-942, March 1991. 3 fig, 3 tab, 12 ref.

Descriptors: *Bieler See, *Crustaceans, *Eutrophic lakes, *Lacustrine environment, *Limnology, *Littoral environment, *Waterfleas, *Zooplankton, Biomass, Comparison studies, Estimates, Seasonal variation.

Data from limnetic and littoral populations of eutrophic Lake Biel, Switzerland, were pooled to calculate length-weight-relationships (LWR), and to determine if physical, chemical or biological conditions of both environments led to significant differences in this relationship, making pooling difficult or impossible. Crustacean populations were sampled with a plankton net from April 1987 to June 1989 weekly at a littoral site and fortnightly at the deepest point of the lake. LWRs were calculated for the cladoceran species of the two sites. For copepods, mean weights for each stage were calculated and tested for significant differences. In general, no significant differences were seen for copepod mean weight between the two sites. The great variability of weight within stages is mainly attributed to seasonal variation in individual dry weight. The distinction between Daphnia hyalina and Daphnia galeata is difficult because several intermediate types can be found. Since LWRs of the two species showed no significant differences, data were pooled into a littoral and a pelagic group. The littoral Daphnias were significantly heavier than the pelagic ones. Spring animals are the heaviest; summer animals are significantly lighter. LWRs might be different for littoral and pelagic populations of the same species, and/or the relationship between body length and weight may show distinct seasonal variation. Applying biomass data from the literature without verifying their applicability to the investigated populations might therefore lead to mistakes in production estimates. (Brunone-PTT)
W91-12711

CONSEQUENCES OF WATER OLIGOTROPHICATION ON MACROPHYTIC VEGETATION OF SWISS LAKES.
Geneva Univ. (Switzerland). Unite de Biologie Aquatique.
For primary bibliographic entry see Field 5G.
W91-12712

PHYTOPLANKTON DEVELOPMENT IN LAKE ZURICH AND CHANGES IN THE VERTICAL LIGHT ATTENUATION COEFFICIENT (KD), THE CONTRIBUTIONS DUE TO GILVIN (KG), PHYTOPLANKTON (KPH) AND TRIPTON (KTR) DURING SPRING 1986.
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
F. Schanz, and V. Felix.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 949-954, March 1991. 4 fig, 1 tab, 17 ref.

Descriptors: *Lake Zurich, *Light intensity, *Light penetration, *Limnology, *Phytoplankton, *Population dynamics, Absorption, Attenuation, Chlorophyll a, Diatoms, Flagellates, Photosynthesis, Spectral analysis.

From January 7 to May 21, 1986, the spectral light attenuation as well as the attenuation of the photosynthetically available radiation were measured in short time intervals in Lake Zurich. As usual in Lake Zurich, a diatom bloom was observed in March and a dense bloom of flagellates (species of Rhodomonas and Cryptomonas) occurred from the end of April to the beginning of May. The results show that the vertical attenuation coefficients, are dominated at every wavelength by the partial attenuation coefficient due to phytoplankton (Kph). Compared with Kph, small variations of the absolute values of the attenuation due to gilvin (Kg) and attenuation due to tripton (Ktr) are noted. Whereas the significance of gilvin in the light attenuation properties of Lake Zurich was always small, Ktr contributed considerably to the vertical attenuation, except during the bloom of flagellates. In this period, the spectral distribution of the downward irradiance was shifted towards the red as a result of the absorption properties of chlorophyll a. Based on these results, the light attenuation properties of Lake Zurich should be taken only from periods of low phytoplankton densities. (Brunone-PTT)
W91-12713

SLUMP INDUCED SURGES AND SEDIMENT TRANSPORT IN LAKE URI, SWITZERLAND.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 2J.
W91-12714

INTERACTIVE PROGRAM FOR CALCULATING THE ONE-DIMENSIONAL DYNAMICAL TEMPERATURE SIMULATION MODEL 'DYRESM' ON A MACINTOSH COMPUTER.
Carbotech, Zurich (Switzerland).
For primary bibliographic entry see Field 7C.
W91-12715

RECENT RE-OLIGOTROPHICATION IN MONDSEE (AUSTRIA) AS INDICATED BY SEDIMENT DIATOM AND CHEMICAL STRATIGRAPHY.
Institut fuer Limnologie, Mondsee (Austria).
For primary bibliographic entry see Field 5G.
W91-12716

ASPECTS OF PHYTOPLANKTON SEASONAL SUCCESSION IN MONDSEE, AUSTRIA, WITH PARTICULAR REFERENCE TO THE ECOLOGY OF DINOBRYON EHRENB.
Institut fuer Limnologie, Mondsee (Austria).
M. T. Dokulil, and C. Skolaut.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 968-973, March 1991. 7 fig, 15 ref.

Descriptors: *Austria, *Diatoms, *Limnology, *Mesotrophic lakes, *Mondsee, *Phytoplankton, *Seasonal variation, *Succession, Algal growth, Bacteria, Decomposition, Dissolved organic matter, Feeding rates, Nutrients, Phosphorus, Sedimentation, Thermal stratification, Trace metals, Water sampling.

The seasonality and ecology of four species of Dinobryon were investigated in Mondsee, Austria, a mesotrophic alpine lake. Integrated samples of the top 20 m were collected every fortnight at a reference station in the western part of the lake. Centric diatoms were sampled weekly in spring 1987. Populations were composed primarily of Dinobryon sociale and D. divergens, with occasional contributions from D. bavaricum and D. cylindricum. Shortly after the onset of thermal stratification in April, Dinobryon abruptly appears in the phytoplankton assemblage. Numbers vary greatly between April and September, due to episodic growth and disappearance. Spring development of Dinobryon is associated with the decline in small centric diatoms at the end of the vernal period and follows the rapid disappearance of Melosira islandica. Concentrations of iron, soluble reactive phosphorus, and total soluble phosphorus were low every year during the period when Dinobryon was present. The appearance of Dinobryon after diatom blooms seems to be related to the release of dissolved organic matter by decaying algae acting as chelators for trace metals. Sedimentation appears to be an important loss process in Dinobryon. These observations indicate that Dinobryon populations are controlled by a number of external and internal factors, such as iron availability, phosphorus uptake capacity, bacterial abundance, grazing and sedimentation losses. As a result, growth may be described as episodes of rapid opportunistic growth often succeeded by abrupt decline. (Brunone-PTT)
W91-12717

ZOOPLANKTON CHANGES IN MONDSEE.
Institut fuer Limnologie, Mondsee (Austria).
A. Nauwerck.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 974-979, March 1991. 3 fig, 2 tab, 27 ref.

Descriptors: *Austria, *Lake restoration, *Limnology, *Mondsee, *Population dynamics, *Species

composition, *Water pollution control, *Zooplankton, Copepods, Epilimnion, Feeding rates, Fish predation, Hypolimnion, Littoral environment, Population density, Rotifers, Trophic status, Vertical distribution, Waterfleas.

Observed changes in the zooplankton of Mondsee, Austria, were compared with other changes during the last few decades, to investigate how closely zooplankton changes can be linked with trophic changes (eutrophication) in the lake. In 1987 and 1988, quantitative samples were taken biweekly, at noon and at midnight, at 3 m depth intervals down to 42 m (near the bottom). Also about 250 preserved samples, from 1943 to 1984 were analyzed microscopically with respect to species composition, numbers, size variation, fertility, and depth distribution patterns. Several species which may have existed in littoral or benthic parts of the lake, have colonized the open water since the 1960's. In 1943, high numbers of Daphnia hyalina were seen. Rotifers became more abundant over time. Most species remained rather constant in size during the years, particularly the large Daphnia and Cyclops. Only Eudiaptomus individuals were distinctly smaller before eutrophication, while the opposite was the case with Eubosmina longispina. Changes were apparently linked to trophic changes of the lake, or at least to changes in food conditions. Food supply has improved and become more concentrated in epilimnic water layers. Small, epilimnic living zooplankters have increased in numbers and productivity. Fish predation has increased in the epilimnion due to an increase in planktivorous Chalcalburnus and Rutilus. In the hypolimnion, predation by Coregonus has become more important while the possible influence of Salvelinus on zooplankton has become greatly reduced. Zooplankton have not shown explicit signs of return to pre-eutrophic conditions. Eutrophication induced by zooplankton increase has never resulted in characteristic clear water phases as an effect of overfiltration, indicating that zooplankton are kept in check by predation. (Brunone-PTT)
W91-12718

NUTRIENT CYCLING IN A FRESHWATER REED MARSH.
Vienna Univ. (Austria). Limnologische Lehrkanzel.
For primary bibliographic entry see Field 5B.
W91-12719

IMPORTANCE OF PICOPLANKTON IN HUNGARIAN SHALLOW LAKES.
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
L. Voros.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 984-988, March 1991. 4 fig, 3 tab, 14 ref.

Descriptors: *Hungary, *Lake Balaton, *Limnology, *Marcali Reservoir, *Picoplankton, *Primary productivity, Biomass, Chlorophyll a, Cyanophyta, Food chains, Photosynthesis, Separation techniques.

The primary production and quantity of two filter fraction (>3 microm and 3.0 to 0.2 microm) of algae were investigated in Lake Balaton during 1986 and in Marcali Reservoir, both in Hungary, during 1987. Measurements were performed between May 28 and November 21, 1986 in the hypertrophic Keszthely-Basin and in the mesotrophic Siofok-Basin of Lake Balaton. Phytoplankton photosynthesis was measured in situ at depths of 15, 30, 60, 100 and 150 cm, and an assimilation number was calculated on the basis of the estimated chlorophyll a content of the cell fractions and the light-saturated rate of photosynthesis. A summer cyanobacterial bloom characteristic of the Keszthely-Basin was also observed in 1986. The highest biomass of algae larger than 3 microm was 45.5 mg/L. The picoplankton biomass ranged between 0.26 and 1.3 mg/L accounting for 0.8 to 34.7% of the total biomass (wet weight). The contribution of picoplankton to the total cell surface was twice as high as their contribution to the total biomass (1.9 to 64.7%). In the Siofok-Basin, the biomass of algae larger than 3 microm ranged between 2.6 and 3.6 mg/L. The picoplankton biomass ranged from between 0.18 and 0.51 mg/L. These small-sized algae made up 4.8 to 16.2% of the total biomass and 28 to 51.6% of the total surface of the phytoplankton. In Marcali Reservoir, the biomass of nanoplankton and microplankton ranged between 11.0 and 23.9 mg/L. The contribution of picoplankton to the total phytoplankton biomass ranged between 2.65 and 22.6% and was 11.9 to 58.4% for total cell surface. Primary production of the picoplankton ranged between 3487 and 8249 mg C/sq m/day, and the picoplankton contribution was between 10.9 and 54.8% of total production. These results show that the contribution of picoplankton to the total planktonic primary production was significantly greater than their contribution to the biomass. (Brunone-PTT)
W91-12720

RELATIVE FREQUENCY, SEASONAL PATTERN AND POSSIBLE ROLE OF SPECIES RARE IN PHYTOPLANKTON IN A LARGE SHALLOW LAKE (LAKE BALATON, HUNGARY).
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
J. Padisak.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 989-992, March 1991. 2 fig, 13 ref.

Descriptors: *Hungary, *Lake Balaton, *Limnology, *Phytoplankton, *Seasonal variation, *Species composition, *Species diversity, Competition, Ecosystems, Population density, Shallow water, Succession.

The quantities of both frequent and scarce species in Lake Balaton, the largest shallow lake in Central Europe, were analyzed on the same numerical basis to attempt (1) to establish the number of species minimally necessary to produce a given particular sequence of seasonal succession; (2) to relate their number to that of others present in the phytoplankton throughout the year; and (3) to estimate the proportion of species having different origins and which can be found together in phytoplankton samples. Algae were counted in an inverted microscope; diatoms were identified in additional light and electron microscopy studies. To estimate the quantity of rare species, the average relative frequency (arf) was used (the total number of enumerated specimens). Temporal aggregativity was measured in terms of maximal relative frequency (mrf). The total number of taxa found in 211 quantitative samples and in additional diatom studies was 417. Two hundred and eighteen species were extremely rare (arf < 1/30,000); 78 species had an arf between 1/30,000 and 1/4000; 59 between 1/4000 and 1/800; 46 between 1/800 and 1/100. Only 14 species had an arf of > 1/100. Approximately 300 of the 417 species were clearly planktonic forms. If the data on small unicellular centric diatoms are not treated separately, three different regions can be distinguished: (1) relatively many species (or groups of co-dominating closely related species) can be found in the mrf range of >1/3, and no more than 2 species dominated in the same period; (2) the relative emptiness of the mrf range of 1/3 to 1/20 indicates this is the density area, in which the outcome of competition is decided in nature; and (3) coexistence or co-occurrence of many species is allowed below the mrf level of 1/20. The observation that many species did not exhibit seasonal peaks at all, and maintained constantly scarce populations, suggests that perennation can be achieved without specialized survival forms and that these constant, scarce populations themselves can be considered as propagules able to begin a rapid increase in favorable environmental conditions. This analysis may be relevant only to similar water bodies; in other lakes, such as small ponds, fishponds and reservoirs, basically different ecological phenomena might be characteristic. (Brunone-PTT)
W91-12721

RESPIRATORY ENERGY LOSS OF ZOOPLANKTON IN LAKE BALATON (HUNGARY) ESTIMATED BY ETS-ACTIVITY MEASUREMENTS.
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
L. G. Toth, and A. V. Drits.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 993-996, March 1991. 2 fig, 1 tab, 18 ref.

Descriptors: *Electron transport, *Hungary, *Lake Balaton, *Limnology, *Primary productivity, *Zooplankton, Algal blooms, Aquatic animals, Cyanophyta, Eutrophic lakes, Feeding rates, Fish, Hypertrophic lakes, Respiration, Seston, Standing crops.

Based on the biochemical test (performed seasonally) of respiratory electron transport system (ETS) activity measurements and ETS/R ratio, the oxygen consumption and daily respiratory energy loss of zooplankton was estimated, and the resulting data related to primary productivity records. As compared to the total planktonic ETS, ETS of the zooplankton was 15.3 in the meso-eutrophic and 5.3 in the hypertrophic area of the lake. The proportion of the zooplankton ETS was especially low during the ordinary late summer peak of filamentous blue-greens in the hypertrophic area. In comparison with primary production, the obtained data show that the respiration of zooplankton/primary production ratio was 0.17 in the meso-eutrophic and 0.03 in the hypertrophic area. The values in the hypertrophic area of Lake Balaton are low, which is in agreement with the results of other zooplankton studies. The standing crop and clearance rate of herbivorous zooplankton in Lake Balaton are generally low, lower than can be energetically expected from primary production and algal blooms. Three main factors responsible for this discrepancy are: (1) the high abiotic seston concentration composed by undigestible mineral particles; (2) the chronic blooms of filamentous blue-greens in the hypertrophic area which can inhibit the normal feeding pattern of herbivorous zooplankton; and (3) an extra impact of cyprinid fish predators on zooplankton. (Brunone-PTT)
W91-12722

PHOTOTROPHIC PROKARYOTES IN A KARSTIC SULPHATE LAKE.
Valencia Univ. (Spain). Dept. of Microbiology.
E. Vicente, M. A. Rodrigo, A. Camacho, and M. R. Miracle.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 998-1004, March 1991. 4 fig, 1 tab, 21 ref. CAICYT Grant 225/86.

Descriptors: *Bacteria, *Chromatium, *Lake Arcas, *Limnology, *Species diversity, *Sulfate lakes, *Sulfur bacteria, Cyanophyta, Hydrogen ion concentration, Oxygen gradient, Population density, Redoxcline, Seasonal distribution, Stratification, Water column.

The special features of the Chromatiacea layers in Lake Arcas-2 Spain, are described in relation to the distribution in the water column of physicochemical factors and of other phototrophic prokaryotes. The vertical distribution of a population of epibiontic bacteria infecting the dominant species of purple sulfur bacteria is explained. Water samples were taken by peristaltic pumping with an 18 cm diameter inlet device, and redox potential and pH were measured. Light, temperature and oxygen profiles were taken in situ. Oxygen isopleths represent clearly the mixing and stratification periods. A sharp oxygen gradient is established during summer stagnation. A thermocline, initiated in June at a depth around 4 m, gets deeper and sharper as summer advances, lasting until late October. Summer stagnation causes a sharp redoxcline at the end of summer, which is located one meter or more below the oxycline. Phytoplankton biomass is not very high. Chromatiacea are found from spring to fall in the anoxic hypolimnion, producing a mass development in late summer and fall located in a thin layer between 8.8 and 9 m depth. Below the purple sulfur bacteria layer, a community of green sulfur bacteria can be found,

whose development is limited by the shading effect of the purple bacteria. In the hypolimnion, a third group of prokaryotes (Oscillatoria) is found in dense populations. The Chromatium cells often had small rod-shaped epibionts attached to them. The abrupt gradients in Lake Arcas-2 are possibly sharpened by the activity of the Chromatium layer, by self-shading and by consumption of the high sulfide supply from below. At the end of its viable period, the mature layer can be very complex and structured, with an assemblage of populations of other groups of organisms. (Brunone-PTT)
W91-12723

HORIZONTAL HETEROGENEITY OF PHYTOPLANKTON IN A SMALL HIGH MOUNTAIN LAKE.
Barcelona Univ. (Spain). Dept. de Ecologia.
L. Camarero, and J. Catalan.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1005-1010, March 1991. 5 fig, 21 ref.

Descriptors: *Fluorescence, *Irradiance, *Lake Baciver, *Lake morphology, *Limnology, *Mountain lakes, *Phytoplankton, *Turbulence, *Water temperature, *Wind-driven currents, Aquatic plants, Chlorophyll, Kinetic energy, Pyrenees Moutains, Water sampling.

Fluorescence and temperature transects from Lake Baciver, a small high mountain lake in the Central Pyrenees, were compared to observe the effect of turbulence on phytoplankton distribution. Heat exchange and wind stress determine a pattern of turbulent kinetic energy dissipation in space as well as in time. Measurements of temperature and fluorescence at 0.5 m depth were recorded at 38 stations 10 m apart along the main axis of Lake Baciver. Profiles were obtained at 4 hour intervals during a 48 hour sampling period, and total irradiance and wind speed were averaged and registered at 10 minute intervals. The transect passes through the central basin and two shallow meadows of Isoetes and Sparganium which surround it. During the sampling period the sky was cloudless and there was strong irradiance. Heating and cooling were more intense in the meadows. Temperature spectra show a large peak at low frequencies and smaller peaks at some higher frequencies. Results indicate a close relationship between water motion at small scales and distribution of phytoplankton. Mechanisms such as convective circulation associated with these morphological constraints could be the cause of variation in this scale. During smooth breeze periods, the fetch and morphology of the lake as well as the macrophyte distribution determine the input of energy through two main windows: (1) at low frequencies, variance is introduced by differential heating and cooling, and (2) at frequencies around 1/60 to 1/30/m wind action and convection produce some kind of turbulent structures in the water mass that govern phytoplankton horizontal heterogeneity. The main source of variation is the formation of frontal structure in the interfaces between the center and littoral zones. Deep water from the basin rises through the lateral boundaries. This water could be richer in nutrients or, more probably, could simply carry up chlorophyll from the deep chlorophyll maximum at the bottom of lake. Heat exchange, which determines thermal stability, and wind stress, which introduces mechanical energy to the system, are responsible for horizontal distribution of phytoplankton in Lake Baciver. Morphological features of the lake determine under different conditions the external energy window size. (Brunone-PTT)
W91-12724

ERGOCLINES AND BIOLOGICAL PROCESSES IN HIGH MOUNTAIN LAKES: SIMILARITIES BETWEEN SUMMER STRATIFICATION AND THE ICE-FORMING PERIODS IN LAKE REDO (PYRENEES).
Barcelona Univ. (Spain). Dept. de Ecologia.
J. Catalan, and L. Camarero.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1011-1015, March 1991. 1 fig, 2 tab, 22 ref.

Descriptors: *Ergoclines, *Ice cover, *Lake Redo, *Limnology, *Mountain lakes, *Phytoplankton, *Pyrenees Moutains, *Seasonal variation, *Thermal stratification, Biomass, Chlorophyll, Limiting nutrients, Organic matter, Phosphorus, Thermocline, Turbulence.

Summer deep chlorophyll maxima (SDCM) and chlorophyll maxima under ice (CMUI) are typical phenomena found in many high mountain lakes. Lake Redo, a high mountain lake in the Pyrenees, can be used to provide a general understanding of pelagic ecosystems. Two main types of ergoclines, sharp transitions from high to low levels of external energy, can be distinguished: (1) in spatial ergoclines, both phases coexist and interact through the interface in the course of time; and (2) in temporal ergoclines, the two phases do not coexist and the interface is ephemeral in relation to the phases. High mountain lakes are usually oligotrophic and more sensitive to changes in the variables which drive the ecosystem. During summer in Lake Redo, a deep chlorophyll maximum develops in the hypolimnion. When the thermocline sinks, chlorophyll in the water column progressively increases as the interface reaches depths that contain more fine sediment. In both ergoclines, the stable phase is cooler, darker and less turbulent than the unstable phase, although the gradient is higher in the summer. The differences between the unstable and stable phases in the standing crop of phytoplankton do not correspond to marked differences in the phytoplankton composition. The pelagic system of Lake Redo is limited by phosphorus throughout the year. Planktonic biomass changes are more conspicuous than changes in the dissolved forms of phosphorus. The SDCM generally forms quickly at 30 to 40 m depths when stratification begins. CMUI is the result of a better adaptation to the light climate and more efficient nutrient recycling. In Lake Redo, dissolved organic matter substantially increases in the CMUI and, as in the SDCM, soluble reactive phosphorus is higher in the chlorophyll peaks. (Brunone-PTT)
W91-12725

DYNAMICS OF PHOTOTROPHIC BACTERIA IN RELATION TO IRON CYCLE IN A MEROMICTIC BASIN OF LAKE BANYOLES.
Institut d'Ecologia Aquatica, Gerona (Spain).
L. J. Garcia-Gil, L. Sala-Genoher, and C. A. Abella.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1016-1019, March 1991. 8 fig, 16 ref.

Descriptors: *Bacteria, *Cycling nutrients, *Iron, *Iron bacteria, *Lake Banyoles, *Limnology, *Meromictic lakes, *Spain, *Sulfur bacteria, *Water chemistry, Chlorobium, Dissolved oxygen, Limiting nutrients, Monimolimnion, Seasonal distribution, Trace metals, Water depth.

The appearance of Fe(2+) and the apparent correlation with the simultaneous development of a Chlorobium phaeobacterioides population have been studied in Banyoles Lake, a karstic lake located in Catalonia, Spain. An attempt was made to understand the sequential chemical processes occurring in the monimolimnion of C-IV, a basin of Banyoles Lake. Thermal stratification begins in May or June, concomitant with the stabilization of the meromictic structure. Once the bottom layer has been isolated, oxygen disappears rapidly. Small quantities of Fe(2+) were found in the monimolimnion between January and March. A population of Chlorobium phaeobacterioides appeared early in spring as S(2-) was almost undetectable. The key for the appearance of soluble iron in the monimolimnion of C-IV lies in the changing conditions derived from the instability of its meromixis. Sulfur phototrophic bacteria Chlorobium phaeobacterioides appeared at 13 m depth under conditions of extremely low sulfide concentration, whereas the iron concentration in the deep water was still increasing. (Brunone-PTT)
W91-12726

BENTHIC FAUNA OF BANYOLES LAKE (NE SPAIN).
Barcelona Univ. (Spain). Dept. de Ecologia.
M. Rieradevall, and N. Prat.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1020-1023, March 1991. 1 fig, 3 tab, 17 ref.

Descriptors: *Benthic fauna, *Lake Banyoles, *Lake morphology, *Limnology, *Spain, *Species composition, *Species diversity, Aquatic animals, Dissolved oxygen, Invertebrates, Midges, Population density, Sublittoral zone, Thermal stratification, Waterfleas.

The characteristic karstic morphology of the Banyoles Lake (with four main basins) and its subterranean water inflow are the origin of the different thermal stratification and dissolved oxygen conditions in each of the basins. This fact determines the benthic fauna of each basin. Three different situations exist. The permanent meromictic basin III has a profundal benthic community composed only of Chaoborus flavicans. In basin IV at 13 to 14 m depth a low oxygen concentration existed from July to November, with a benthic community present from February until October with low species richness and densities. Chaoborus flavicans and chironomids are the most abundant macroinvertebrates. Finally, basin I has rich benthic fauna, due to the very short anoxia period (one month). At 20 m deep, the macroinvertebrates are dominated by Oligochaeta, Chironomidae and Chaoborus. At 12 m chironomids are the most abundant, then Oligochaeta, Chaoborus and Gammaridae. In the upper sublittoral zone (5 m), benthos is still more diverse, with large numbers of chironomids and the presence of Ephemera. The Chydoridae, mainly Leydigia, were replaced by the cladoceran Iliocrypta with depth. (Brunone-PTT)
W91-12727

ORIGIN OF DEEP ALGAL MAXIMA: THE CASE OF LAKE CISO.
Universidad Autonoma de Barcelona (Spain). Dept. of Genetics and Microbiology.
J. M. Gasol, and C. Pedros-Alio.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1024-1028, March 1991. 4 fig, 18 ref.

Descriptors: *Bacteria, *Lake Ciso, *Limnology, *Nutrients, *Population density, *Thermocline, Biomass, Dissolved oxygen, Epilimnion, Metalimnion, Seasonal distribution, Sulfides, Vertical distribution.

In small and stable lakes deep cell maxima (DCM) are found at the thermocline or at the nitracline. In Lake Ciso, Spain, where several species form metalimnetic maxima, mechanisms responsible for the origin of maxima of different species were tested. An extremely sharp thermocline develops in summer, between 1 and 2 m. While the epilimnion is rich in oxygen, the hypolimnion has large concentrations of sulfide. When discrete samples are taken at closely spaced intervals, several phototrophic eukaryotes are found to be concentrated just above the phototrophic bacterial layer. These organisms reach higher concentrations at the metalimnion than at the epilimnion. Mechanisms for the origin of DCM can be grouped into three categories: those involving in situ growth, those involving epilimnic growth followed by sinking to deeper layers, and those involving differential losses. By simultaneously following integrated biomass and depth distribution of organisms, determination of whether a DCM is formed by in situ growth or by other mechanisms is possible. (Brunone-PTT)
W91-12728

LIMNOLOGICAL CYCLE OF THE COASTAL LAGOON LA MASSONA (GIRONA, NE SPAIN): ORIGIN, DYNAMICS AND INFLUENCE OF THE SPORADIC SEAWATER INFALLS ON THE MEROMIXIS.
Institut d'Ecologia Aquatica, Gerona (Spain).

For primary bibliographic entry see Field 2L.
W91-12729

IN SITU AND IN VITRO CONSUMPTION OF TOTAL ORGANIC CARBON IN LAKE WATER AS DETERMINED BY MICROANALYSIS.
Istituto Italiano di Idrobiologia, Pallanza (Italy).
R. Bertoni, C. Callieri, A. Ragazzoni, and G. Cardini.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1032-1034, March 1991. 3 fig, 7 ref.

Descriptors: *Bacteria, *Carbon cycle, *Lake Maggiore, *Limnology, *Microbiological studies, *Organic carbon, Decomposition, Primary productivity, Productivity, Regression analysis, Statistical analysis, Water sampling.

Measured values of organic carbon variation in lake water were used to evaluate microbial heterotrophic activity in vitro and its coupling with autotrophic production in situ. The in vitro measurements of microbial heterotrophic activity and bacteria direct counts were done monthly from August 1986 to October 1987 on samples taken at 5 m depth in Lake Maggiore, Italy. For each in vitro experiment, the regression of total organic carbon (TOC) concentration over time during the dark incubation period was calculated, and the slope of this line assumed to be the mean TOC consumption rate. During this period, the in vitro TOC consumption rates varied from 2 to 16 microg C/L/hr; in two cases the regression was not statistically significant and therefore the rate was considered to be zero. At the end of summer 1986, when TOC values were high, the microheterotrophs consumed organic substrates at a high rate. In April, organic substrate concentrations increase because of the rapid growth of phytoplankton populations. A parallel rise in the microbial heterotrophic activity is evident. The relationship between TOC concentration and TOC consumption is strong enough to be statistically significant at the $P<0.05$ level when checked with Spearman's rank-order test. From February to July 1987, once a month, an automatic sampler was suspended at 5 m depth to follow the TOC concentration variations due to production and decomposition processes during the day-night cycle in situ. From the in situ experiment, the initial TOC concentration was reduced by 20% within two hours, suggesting that the organic substrate is probably very labile. The TOC initial consumption rates measured in situ were always higher than the rates measured in vitro. From the results, the critical step when conducting in vitro estimation is the measurement of TOC concentration from which to compute the heterotrophic consumption rate. (Brunone-PTT)
W91-12730

CLADOCERA POPULATIONS IN TRASIMENO LAKE (ITALY) 16/07/87 TO 28/12/88.
Perugia Univ. (Italy). Ist. di Idrobiologia e Pescicultura.
M. I. Taticchi, I. Artegiani, and C. Isa.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1049-1057, March 1991. 9 fig, 1 tab, 6 ref.

Descriptors: *Italy, *Limnology, *Population dynamics, *Trasimeno Lake, *Waterfleas, Fecundity, Population density, Species composition, Trophic status, Water sampling.

Lake Trasimeno is a laminar lake near Perugia, Italy, at an average altitude of 258 m above sea level. The degree of trophy could be evaluated from the study of the dynamics of pelagic cladocerans, which have remarkable influence on the composition of the plankton in the lake during the year. Plankton was collected through a suction pump with a 180 microm net from July 1987 to December 1988. For every sampling date, the following were evaluated: density/L of young and adults; ovigerous females and eggs; instantaneous birth rates; instantaneous population growth rates; instantaneous death rates; fecundity = eggs/ovigerous females. Bosmina longirostris and Daphnia galeata showed the highest values of fecundity during the periods of the lowest density. In Lake Trasimeno, the two species showed a certain regulatory mechanism, that seems to be intrinsic to the population. Diaphanosoma brachyurum and Ceriodaphnia pulchella showed regulatory mechanisms extrinsic to the population; in fact the highest fecundity values coinciding with the highest density determined rather large and rapid fluctuations of the two species. The same dimension of the clutch could indicate a stress of the two populations. (Brunone-PTT)
W91-12734

LIMNOLOGY OF LAKE CHIUSI AND LAKE MONTEPULCIANO (SIENA--ITALY).
Perugia Univ. (Italy). Ist. di Zoologia.
M. V. Giovanni, M. I. Taticchi, and L. Mantilacci.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1058-1065, March 1991. 7 fig, 2 tab, 6 ref.

Descriptors: *Italy, *Lake Chiusi, *Lake Montepulciano, *Limnology, *Phytoplankton, *Zooplankton, Algal growth, Copepods, Population density, Protozoans, Rotifers, Seasonal variation, Trophic status, Water sampling, Waterfleas.

Lake Chiusi and Lake Montepulciano, in Central Italy where Tuscany borders Umbria, are connected to each other through the Fosso della Ripa. Studies of the area were carried out for fifteen months, from June 1987 to August 1988, on five sampling stations, to evaluate the environmental characteristics of the system. Phytoplankton and zooplankton were sampled on the surface, and every 50 cm down. The measurement of the temperature of the water showed a seasonal gradient which was higher in Lake Montepulciano than in Lake Chiusi. For the temporal succession of phytoplankton, all classes (excluding Chlorophyceae in Lake Chiusi and ultraplankton in both lakes) showed heavy densities in different months followed by rapid falls and minima. The algal density seen in Lake Montepulciano is almost always heavier than in Lake Chiusi. In general, the zooplankton found in the central station is constituted by the following (in order of density): Rotifera, Protozoa, Cladocera, and Copepoda. The density is inversely correlated to the temperature of the water. Organisms with r-strategies are prevalent, particularly in Lake Montepulciano where even the environmental factors are very variable and unstable. The benthic community in Lake Chiusi has a larger number of individuals where approximately equal percentages of Diptera (45.5%) and Tubificidae (52.4%) are found. In Lake Montepulciano, Insecta (84.6%) are dominant over Oligochaeta (15.1%). The lotic-lentic system was generally highly trophic. (Brunone-PTT)
W91-12735

VERTICAL DISTRIBUTION OF THE ROTIFER FAUNA AND ITS SEASONAL CHANGES IN THE PLITVICE LAKES, CROATIA--YUGOSLAVIA.
Zagreb Univ. (Yugoslavia). Dept. of Zoology.
R. Erben.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1066-1068, March 1991. 4 fig, 6 ref.

Descriptors: *Croatia, *Limnology, *Plitvice Lakes, *Rotifers, *Yugoslavia, Biomass, Chlorophyll a, Dissolved oxygen, Invertebrates, Korana River, Population density, Primary productivity, Seasonal variation, Species diversity, Vertical distribution, Water chemistry, Water sampling, Water temperature.

Plitvice Lakes, the source of the River Korana, are composed of sixteen lakes overflowing in cascades making travertine barriers. The zooplankton, particularly rotifers, were quantified in the lakes for the summer and fall seasons. Samples were collected on the vertical profile in the deepest points of the Lakes Prosce, using Van Dorn water samplers 5 L in volume, at every 5 m of depth. The vertical distribution of rotifers in the Prosce Lake shows the smallest density of the population in the surface layer (up to 5 m depth) of the water. In the early spring with the occurrence of a slightly pronounced epilimnion, the largest population densities were collected in the water layer between 10 and 15 m depth. The largest abundance of Keratella cochlearis, a bacteria-feeding rotifer, were found in June and July in the 20 m depth. Rotifers represent about 91.6% of the zooplankton in the summer. The species found in the Kozjak Lake were poorer in the number of individuals. The total mass of rotifers represented 92.1%. The physico-chemical parameters did not show any significant correlation to the rotifer species, except the thermal changes which cause the stratification in the lakes and the quantity of the primary production expressed as chlorophyll a. The temperature values ranged from 4.5 to 20 C. Oxygen concentrations were always about 11 mg O2/cubic m. These differences of the trophy between the Prosce and Kozjak Lakes could be explained by their position and hydrographic characteristics of all teh Plitvice Lakes: Prosce Lake is shallower than Lake Kozjak; and Prosce Lake is right at the beginning of the system, receiving mineral salts first. The maximum density of the rotifer population has been detected in the lower part of the metalimnion and the beginning of the hypolimnion. The increased biomass in both lakes and changes in population dynamics are due to the increasing exploitation of the area as a tourist center. (Brunone-PTT)
W91-12736

NITRATE REDUCTASE ACTIVITY IN FRESHWATER PHYTOPLANKTON.
Kinneret Limnological Lab., Tiberias (Israel).
D. Wynne.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1069-1072, March 1991. 3 fig, 10 ref.

Descriptors: *Algal blooms, *Dinoflagellates, *Enzyme activity, *Israel, *Lake Kinneret, *Limnology, *Nitrate reductase, *Phytoplankton, *Population dynamics, Ammonium, Biomass, Freshwater, Nitrates, Nitrogen, Nutrient concentrations.

The Kinneret, situated in north Israel, is the only natural freshwater lake in the country. The phytoplankton population in the lake is dominated by an annual bloom of freshwater dinoflagellates (Peridinium gatunense). Maximum biomass is also reached in late spring, approximately coinciding with high nitrate concentrations in the epilimnion. Concentrations of dissolved inorganic nitrogen nutrients measured in the Kinneret showed a typical pattern for the lake epilimnic waters. A peak of ammonium was first noted, followed by that of nitrate. Phytoplankton biomass reached highest values in the period roughly corresponding to the maximum nitrate concentration in the water when the algal population was essentially entirely comprised of Peridinium. Nitrate reductase activity in the lake rose to maximum levels during the peak of the Peridinium bloom. Nitrate reductase activity partially reflected the prehistory of the cells, since nitrate was required to induce enzyme synthesis. However, nitrate reductase activity was proportional to nitrate concentrations only at low ammonium levels. Furthermore, nitrate reductase activity could be detected in algal cells even when ambient ammonium concentrations were high. (Brunone-PTT)
W91-12737

CAN LITTORAL RESOURCES INFLUENCE ECOSYSTEM PROCESSES IN LARGE, DEEP LAKES.
Tel-Aviv Univ. (Israel). Inst. for Nature Preservation Research.
A. Gasith.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1073-1076, March 1991. 2 fig, 17 ref.

Descriptors: *Ecosystems, *Lake Kinneret, *Lake ecology, *Limnology, *Littoral environment, *Pe-

lagic environment, Israel, Juvenile fish, Organic matter, Phytoplankton, Water level.

Lake size can influence littoral-pelagic size relationships, but the role of the littoral zone in large lakes is still little understood. The decline in the portion of Lake Kinneret, Israel, occupied by the littoral zone with increasing lake size can be considered as a functionally related, distinguishing feature for lake size categories. As the size of the lake increases, the major source of organic matter gradually shifts from the macrophytes in the littoral to the phytoplankon in the pelagic zone. However, non-metabolic littoral resources such as stony, sandy or vegetative substrates are irreplaceable. Non-metabolic interactions, such as across habitat movement of fish, for reproduction, would have an influence on ecosystem processes in large lakes. Such interactions should involve dominant biotic components which depend on structural resources in the littoral for at least a certain stage of their life cycle. Variations in water level fluctuations in Lake Kinneret may cause yearly variations in the available of suitable spawning substrate for the larvae, which could influence the recruitment success of the young-of-the-year. This influence is expected to have a cascading effect on the zooplankton and phytoplankton populations. (Brunone-PTT)
W91-12738

LIMNOLOGY OF HIGH ALTITUDE LAKES OF HIMALAYAN REGION.
Kashmir Univ., Srinagar (India). Centre of Research for Development.
D. P. Zutshi.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1077-1080, March 1991. 2 fig, 5 tab, 10 ref.

Descriptors: *Himalayan Mountains, *Kounsarnag Lake, *Limnology, *Mountain lakes, Alipather Lake, Ammonium, Diatoms, Dissolved organic carbon, Gangbal Lake, Lake morphology, Nutrient concentrations, Phosphorus, Rainfall, Rotifers, Sediment chemistry, Sheshnag Lake, Species diversity, Thermal stratification, Trace minerals, Transparency, Water temperature, Zooplankton.

The high altitude lakes of northwest Himalaya occupy an intermediate position between the Ladakh lakes exposed to cold desert conditions and central Himalayan lakes which receive abundant summer monsoon rains. The lakes are mostly small-sized with maximum surface area of 157 ha and 137 ha recorded for Gangbal and Kounsarnag lakes. Various thermal events, such as summer stratification and the onset of isothermy, do not follow any predictable pattern. The lakes in the south and southwest are exposed to lower temperature conditions than the lakes in north and northeast. Low Secchi transparency has been noted in Himalayan lakes, due to glacial silt present in them. The pH (8.3 to 9.2) of the lake waters showed significant changes. The concentration of phosphorus and ammonium-nitrogen in Sheshnag Lake were much higher than the values seen for other lakes. Lake sediments were poor in organic carbon and basically sandy. The sediments of Sheshnag Lake were richer in organic carbon than the Tulyan Lake. The predominant minerals were chlorite, amphibole, and quartz. The phytoplankton population was dominated by diatoms, with the maximum number of diatom species found in Sheshnag and Alipather Lakes. The lakes supported low to moderate zooplankton populations, with rotifers dominant. (Brunone-PTT)
W91-12739

CURRENT SITUATION AND CHANGING TENDENCY OF WATER POLLUTION IN MAIN LAKES OF CHINA.
Nanjing Inst. of Geography and Limnology (China).
For primary bibliographic entry see Field 5C.
W91-12740

ANALYSIS OF PHYTOPLANKTON SIZE USING OPTICAL FIBER CABLES WITH THE LASER TECHNIQUE.
Kinki Univ., Higashiosaka (Japan). Dept. of Fisheries.
R. Tsuda, Y. Kakui, and M. Kumagai.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1088-1090, March 1991. 5 fig, 5 ref.

Descriptors: *Fiber optics, *Lake Biwa, *Limnology, *Measuring instruments, *Phytoplankton, *Plant morphology, Biological sampling, Japan, Microscopic analysis, Population density, Species composition.

The development of an instrument for measuring in situ spectra is highly desirable for understanding spatial and temporal changes of species composition and the interactions of physical aspects and the ecological structures. The prototype is composed of a submersible sensing device connected to a laser, a photomultiplier, a pulse height analyzer and a microcomputer by optical fibers. The size distribution of Prorocentrum minimum and Skeletonema costatum was computed with this system of particle size analysis, and the size (ranging from 11 to 15 microm) was comparable to that of microscopic observations. In the south basin of Lake Biwa, spatial distribution of size spectra changes considerably with the location. The population was dominated by Melosira granulata, which ranged in diameter from 15 microm to 30 microm. This technique yielded useful data on the in situ size spectra of phytoplankton and could perform measurements at high speed. (Brunone-PTT)
W91-12742

BENTHIC OXYGEN CONSUMPTION IN LAKE SUWA.
Nagano Prefecture Junior Coll. (Japan).
K. Takada, and K. Kato.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1091-1094, March 1991. 2 fig, 2 tab, 8 ref.

Descriptors: *Benthos, *Eutrophic lakes, *Lake Suwa, *Limnology, *Oxygen requirements, *Respiration, Aquatic animals, Bacteria, Biomass, Japan, Marine environment, Saturation zone, Water sampling.

The respiratory activities of macrozoobenthos, microzoobenthos, and bacteria were quantified to evaluate their contribution to the oxygen consumption at the water-mud interface in Lake Suwa, a shallow eutrophic lake in Japan. Mud samples and zooplankton were collected in triplicate from the center of the lake with an Ekman-Birge grab of 15 cubic cm. Oxygen consumption rate of mud samples of June 21, when the in situ bottom temperature and dissolved oxygen concentration were 15.9 C and 65.4%, was 79.3 microg O2/g/wet mud/hour under 100% oxygen saturation and 15 C. if the initial oxygen concentration of incubation was low, the oxygen consumption of the mud decreased. A significant part of oxygen consumption was due to the activity not inhibited by formalin. The estimated biological mud oxygen consumption under saturated oxygen could reflect approximate in situ activity. The contribution of the respiratory activity of dominant macrozoobenthos to total benthic respiration is calculated from the in situ biomass and respiratory activity. Limnodrilus shows the greatest activity (11.8 microg O2/wet weight/hour in May. Benthic respiration was 8.3 g O2/sq m/day for May, 6.1 for June, and 15.9 for July. These rates for Lake Suwa were significantly larger than those reported for nearshore marine environments, due to the difference in trophic state and the importance of benthic activity of microzoobenthos and macrozoobenthos. (Brunone-PTT)
W91-12743

SEASONAL AND VERTICAL OCCURRENCES OF PLANKTON FOR 5 YEARS IN A LAKE CIRCULATED BY POWER PLANT.
Nihon Univ., Tokyo. Biological Lab.
M. Sudzuki, T. Matsumoto, and K. Narita.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1095-1101, March 1991. 4 fig, 2 tab, 11 ref.

Descriptors: *Chrysophyta, *Cooling water, *Copepods, *Electric powerplants, *Limnology, *Population dynamics, *Waterfleas, Eutrophication, Feeding rates, Japan, Lake Numasawa, Population density, Seasonal distribution, Stream discharge, Vertical distribution.

The effects of river water discharged from an electric power plant on the seasonal and vertical distribution of lake plankton were evaluated in Lake Numasawa, Japan. For cladocerans, no changes in population dynamics were noted in the samples. For copepods and nauplii, densities seem to be higher for nauplii before the summer. Chrysophyceae increased in the lake. Since most taxa seemed to increase in density, the lake water seems to be in a process of eutrophication. Seasonal and vertical occurrences of cladocerans and copepods are affected by fish in the lake. Fish feeding preferences depended on the age of the fish and the season of the year. (Brunone-PTT)
W91-12744

COMPARATIVE VIEW OF LAKES NYOS AND MONOUN, CAMEROON, WEST AFRICA.
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
G. W. Kling, W. C. Evans, and M. L. Tuttle.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1102-1105, March 1991. 1 fig, 4 tab, 15 ref. NSF Grants BSR-8400532, BSR-8544206, EAR-8709978.

Descriptors: *Cameroon, *Carbon dioxide, *Human population, *Lake Monoun, *Lake Nyos, *Limnology, *Volcanoes, Fermentation, Gases, Methane, Mortality, Trace metals, West Africa.

The release of gas from lake waters and sediments is a common occurrence and can be an important component in lake budgets of carbon and sulfur. Dramatic releases of CO2 resulting in the loss of human life, however, are unique to Lakes Nyos and Monoun. None of Cameroon's 39 natural crater lakes show evidence of abnormal heat input from volcanic activity. Epilimnetic activity of all of Cameroon's lakes are similar; however, high concentrations of Fe(II) and HCO3(1-) in Lakes Nyos and Monoun require that PCO2 must have been high long before the initial gas bursts. The bulk of CO2 released was stored in the lakes prior to each event. Relatively low concentrations of Fe(II) and HCO3(1-) in other Cameroon lakes indicate a low probability of gas bursts from these lakes in the near future. Hypolimnetic concentrations of CO2 remain extremely high in Lakes Nyos and Monoun, and are at least an order of magnitude greater than the concentration in other deep Cameroon crater lakes. Isotopic evidence suggests that CH4 in Lakes Nyos and Monoun is derived mainly from fermentation reactions and CO2 reduction; inputs of abiogenically derived CH4 are minor. (Brunone-PTT)
W91-12745

LIMNOLOGICAL ASPECTS OF LAKE TURKANA, KENYA.
Norsk Inst. for Vannforskning, Oslo.
D. Liti, T. Kallqvist, and L. Lien.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1108-1111, March 1991. 4 fig, 1 tab, 10 ref.

Descriptors: *Fisheries, *Kenya, *Lake Turkana, *Limnology, *Nutrient concentrations, *Omo River, *Thermal stratification, *Water circulation, *Water level, Algal physiology, Basin lakes, Bioassay, Dissolved oxygen, Evaporation, Nitrogen, Phosphorus, Seasonal variation, Suspended matter, Water temperature.

Lake Turkana, Kenya, is a closed basin lake in which the water level has gradually decreased 60 to 80 m to the present 380 m above sea level. The seasonal inflow of the main River Omo comprises 90% of the total influx. Fisheries are important

sources of protein and income for the surrounding population. Recordings of temperature and dissolved oxygen revealed an annual stratification cycle with the most stable stratification cycle between March and May and complete circulation in June and July. During the rest of the year, vertical mixing was partly restricted by a temperature gradient of 1 to 2 C from surface to bottom (70 m). Afternoon dissolved oxygen concentration was above saturation near the surface, but varied considerably in the deep water, depending on the temperature stratification. The lake level receded during the study and reached the lowest level in 30 years in July 1988. Because of the lack of a surface outlet, salts brought to the lake by the rivers are accumulated in the lake as water is lost by evaporation. Analysis of plant nutrients showed very high and stable concentrations of phosphorus (1.8 to 2.4 mg phosphorus/L), while the total nitrogen concentration was comparatively low (0.6 to 2.1 mg N/L). Approximately 85% of the total nitrogen occurred as dissolved compounds; however, only a small portion is in forms readily available as nutrients for algal production. Algal assays showed nitrogen as the potentially limiting nutrient. The horizontal distribution of chlorophyll a in the surface water showed a gradient in phytoplankton density from north to south. The water in Lake Turkana is always turbid, because of fine suspended particulate material. Light extinction is high and transparency is low. The primary productivity in Lake Turkana (0.7 to 0.8 kg C/sq m/year) is higher than Tanganyika and Lake Malawi, but slightly lower than Lake Victoria. (Brunone-PTT)
W91-12746

PRIMARY PRODUCTION IN LAKE NAIVASHA, KENYA.
Leicester Univ. (England). Dept. of Zoology.
D. M. Harper.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1112-1116, March 1991. 1 fig, 1 tab, 16 ref.

Descriptors: *Ecosystems, *Food chains, *Kenya, *Lake Naivasha, *Limnology, *Nutrients, *Primary productivity, Aquatic plants, Freshwater, Sedimentation, Species composition, Succession, Vegetation.

Lake Naivasha is a freshwater lake in the Eastern Rift valley of Kenya, with no surface outlet. Mechanisms which maintains freshness indicate dilute inflows, biochemical and geochemical sedimentation and seepage losses. Various changes in the vegetation composition were evaluated as to their effect on the overall autochthonous primary production sustaining the lake ecosystem. Primary production of the submerged aquatic macrophyte community was measured in 1988. Calculations of productivity were compared with the area of each vegetation type to evaluate their respective contribution to the lake's secondary producers. Three successive changes of aquatic vegetation change can be identified: the initial phase, of a full fringing aquatic plant community; a reduced phase when submerged and floating-leaved macrophytes were completely absent; and a recovery phase, when submerged macrophyte beds reappeared. During the initial phase, gross primary production (GPP) of phytoplankton was 340 to 570 mg O2/sq m/hour. In the reduced phase, the GPP was 350 to 630 mg O2/sq m/hour, and in the recovery phase, GPP was 1.3 g O2/sq m/hour. Submerged macrophyte production is close to the upper range of submerged tropical freshwater plants. Areas of future study include the development of nutrient budgets, the immediate fate of primary production, and the importance of primary producer component diets. An understanding of the sources of the primary production, and of the proportion of herbivory to detritivory in food chains is an essential prerequisite to evaluation of these proposals. (Brunone-PTT)
W91-12747

COMPOSITION, DISTRIBUTION AND ECOLOGICAL ROLE OF ZOOPLANKTON COMMUNITY IN LAKE VICTORIA, KENYA WATERS.
Nairobi Univ. (Kenya). Dept. of Zoology.
K. M. Mavuti, and M. R. Litterick.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1117-1122, March 1991. 1 fig, 3 tab, 10 ref.

Descriptors: *Ecological distribution, *Ecosystems, *Eutrophication, *Fishkill, *Kenya, *Lake Victoria, *Limnology, *Species composition, *Water quality, *Winan Gulf, *Zooplankton, Bioindicators, Biomass, Copepods, Phytoplankton, Rotifers, Species diversity, Trophic status, Water pollution, Water sampling, Waterfleas.

Zooplankton investigations were carried out in the Winan Gulf and Main Lake Victoria, Kenya waters, between June 1984 and March 1987, during multidisciplinary studies on water quality and fish mortalities in the lake. Samples of zooplankton were collected from 28 sampling stations, using a 5 L MacVuti volume sampler. The zooplankton community of Lake Victoria consisted of three major groups, Copepoda, Cladocera and Rotifera. Overall, 35 genera and 49 species of zooplankton were identified from the samples collected at the 28 stations. Species diversity generally increases with decreasing organic productivity and eutrophication in the Lake. Lower densities of Copepoda and Cladocera are found in waters immediately offshore from the riverine inputs. Cladocerans are the least abundant of the major zooplankters. The open water areas are organically less productive than the inshore areas in the Gulf and Kisuma Bay. In terms of phytoplankton biomass concentration, most of the Winam Gulf is eutrophic with the exception of offshore deep water areas, whereas the Main lake waters are less eutrophic. Selected species of zooplankton, especially among the cladocerans and rotifers, may be used as indicators of organic and chemical pollution in the Gulf waters in view of the current high rate of agrochemical and industrial waste water discharges into the Lake from the many food processing factories within the catchment, and from the surrounding towns. (Brunone-PTT)
W91-12748

CYANOBACTERIAL NITROGEN FIXATION IN LAKE KARIBA, ZIMBABWE.
Zimbabwe Univ., Harare. Dept. of Biological Sciences.
S. M. Mayo.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1123-1127, March 1991. 2 fig, 20 ref. University of Zimbabwe Research Board Grant No. 2.9999/10.2844.

Descriptors: *Algal physiology, *Chlorophyll a, *Cyanophyta, *Kariba Lake, *Limnology, *Nitrogen fixation, *Primary productivity, *Zambezi River, *Zimbabwe, Alkalinity, Conductivity, Factor analysis, Hydrogen ion concentration, Nitrates, Nitrites, Photosynthesis, Prediction, Regression analysis.

Lake Kariba was formed when the Zambezi River was impounded at Kariba in 1958. The levels of cyanobacterial nitrogen fixation were quantified to find out how the process was related to biological, physical and chemical parameters of the lake. Chlorophyll a and cyanobacterial nitrogen fixation were assayed, as well as primary production. Photosynthetically active radiation was measured in air or water. The whole data set was analyzed using univariate analysis. Factor analysis showed that the variable group containing pH, alkalinity, and conductivity was inversely related to that of biological nitrogen fixation, phytoplankton primary production, and turbidity. The phytoplankton succession in the lake consisted of two maxima, a diatom peak in the cool-dry season and increased cyanobacterial biomass in the hot-dry and hot-wet season. No inverse correlation existed between cyanobacterial nitrogen fixation and either ammonium nitrogen or nitrate-nitrite-nitrogen. The results did not support the hypothesis that nutrient levels determine cyanobacterial nitrogen fixation. Multiple regression and factor analysis revealed that alkalinity, conductivity, light penetration, ammonium-nitrogen and pH were potentially the most useful parameters in the prediction of cyanobacterial nitrogen fixation. A model incorporating alkalinity, conductivity, and nitrate-nitrite may be of significant predictive value for cyanobacterial nitrogen fixation in Lake Kariba. (Brunone-PTT)
W91-12749

USE OF ALUMINIUM SULPHATE TO CONTROL ALGAL BLOOMS AND CHIRONOMIDS IN JACKADDER LAKE, WESTERN AUSTRALIA.
Murdoch Univ. (Western Australia). School of Biological and Environmental Sciences.
For primary bibliographic entry see Field 5G.
W91-12750

SALINE LAKE MICROCOSMS (MICROECOSYSTEMS) AS A METHOD OF INVESTIGATING ECOSYSTEM ATTRIBUTES.
Adelaide Univ. (Australia). Dept. of Zoology.
W. D. Williams.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1134-1138, March 1991. 2 fig, 2 tab, 27 ref.

Descriptors: *Australia, *Ecosystems, *Lake Cantara South, *Limnology, *Saline lakes, Microcosms, Phytoplankton, Population density, Salinity, Species diversity.

Microcosms were derived from Lake Cantara South, a large shallow ephemeral saline lake in southeast South Australia. This lake is does not have high species richness, the most important submerged macrophyte is Ruppia tuberosa, and a variety of phytoplanktonic species occur (but population densities are low). Surface sediments of Lake Cantara South were removed in plots of size 20 x 20 x 4 cm towards the end of the dry season, and used to plate aquaria filled with distilled water with salinities adjusted to the lake salinity. Salinities were continually adjusted in accordance with lake salinity. During 1988 and 1989, all major faunistic components of the Lake hatched from the sod in the microcosms and formed populations, and Ruppia emerged, grew profusely and flowered. The results show a gross similitude between the microcosm communities and those in the lake. The use of salt lake microcosms may offer at least some resolution of the major dilemma facing ecologists with regard to ecosystems: how to gain holistic insight without the help of severely reductionist techniques. (Brunone-PTT)
W91-12751

MICROBIAL MICROCOSMS OF THE CHEMOCLINE OF A MEROMICTIC LAKE IN RELATION TO CHANGING LEVELS OF PAR.
Valencia Univ. (Spain). Facultat de Ciencias Biologicas.
For primary bibliographic entry see Field 6G.
W91-12752

YEAR TO YEAR FLUCTUATION IN ZOOPLANKTON IN A SMALL MOUNTAIN LAKE.
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
V. M. Stout.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1145-1148, March 1991. 2 fig, 3 tab.

Descriptors: *Copepods, *Lake Grasmere, *Limnology, *Mites, *Mountain lakes, *New Zealand, *Population dynamics, *Rotifers, *Species composition, *Waterfleas, *Zooplankton, Annual variation, Chlorophyll, Diatoms, Phytoplankton, Rainfall, Seasonal variation, Species diversity, Suspended sediments, Transparency, Water temperature.

Lake Grasmere is a small lake situated in a mountain valley in the South Island of New Zealand, formed by glacial activity. The seasonal temperature changes of the lake water showed a similar pattern each year with little year to year variation. The highest temperatures were found in January

and February and were usually about 20 C, the range in maximum temperature between years being 18.9 C to 21.2 C. The pattern of Secchi disk visibility in the lake varied from year to year. The decrease in visibility in late winter and early spring was often caused by large amounts of silt in the lake water and corresponds to times of abundant rainfall. The amount of phytoplankton showed a spring maximum in October of each year, with a more variable chlorophyll maximum occurring in late summer to autumn. The phytoplankton was dominated by diatoms with some greens, especially filamentous, algae occurring more erratically. The species of phytoplankton occurring during the summer were more variable between years. The zooplankton of Lake Grasmere did not include any species of Daphnia or calanoid copepods. The cyclopoid copepods were mostly nauplii together with some copepodites. The macroscopic zooplankton consisted of two small species of cladocera, abundant rotifers, and a species of mite. The spring phytoplankton maximum was followed in October and November with an increase in the population density of herbivorous rotifers, followed by an increase in the numbers of small cladocerans. In the zooplankton, comparing different years, a maximum of rotifers were noted in October and November, followed by cladocerans in December, a short clearwater phase, and in summer a variable mixture of rotifers and crustacean species. (Brunone-PTT)
W91-12753

NUMBERS AND ACTIVITY OF BACTERIO- AND PHYTOPLANKTON IN CONTRASTING MARITIME ANTARCTIC LAKES.
British Antarctic Survey, Cambridge (England).
J. C. Ellis-Evans.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1149-1154, March 1991. 4 tab, 33 ref.

Descriptors: *Algal growth, *Antarctic, *Aquatic productivity, *Bacteria, *Bacterioplankton, *Heywood Lake, *Limnology, *Phytoplankton, *Sombre Lake, *South Orkney Islands, *Trophic status, Biomass, Cyanophyta, Electron transport, Eutrophic lakes, Mesotrophic lakes, Nutrient concentrations, Oligotrophic lakes, Picoplankton, Population density, Signy Island, The Wallows, Turbidity.

Measurements were taken of bacterial and algal production for three contrasting freshwater systems (Sombre Lake, Heywood Lake, and the Wallows) at Signy Island, one of the South Orkney Islands in the maritime Antarctic region. Sombre Lake is clear and oligotrophic, with a sparse phytoplankton population; Heywood Lake is turbid and broadly mesotrophic, with a high biomass of phytoplankton; the Wallows is shallow, with high nutrient loadings and a dense phytoplankton population. Nutrient data indicates marked differences between the three systems. The chlorophyll a concentration recorded from Sombre Lake is typical of unenriched high latitude freshwaters, as is the primary productivity value. Excreted DOC was not significantly different from control values. Heywood Lake phytoplankton and the Wallows phytoplankton are similar to high latitude lakes of similar nutrient input. The phytoplankton of all three systems were dominated by the picoplankton fraction, most notably a Synechococcus-like cyanobacterium. In Sombre Lake, nanoplankton and flagellates were the other major components. Size fractionation studies of primary production indicated that picoplankton accounted for 31% of the total carbon-14 uptake in the Wallows, nanoplankton accounted for 49% and net plankton the remainder. The INT viable count technique gave a high percentage of bacteria showing electron transport activity in Sombre Lake and steadily lower percentages with increasing trophic status. Sombre and Heywood Lake samples had linear growth rates for the entire 24 hour period, but the Wallows samples remained linear for only 15 to 18 hours. DNA constituted only 30 to 41% of the total precipitate in thymidine incorporation experiments. Preliminary work at Signy Island suggests that horizontal variation in mean cell volume across shallow systems such as the Wallows may exist. Caution is necessary in interpreting bacterial production rates obtained with this data. (Brunone-PTT)
W91-12754

LIMNOLOGY OF LAKE XOLOTLAN, NICARAGUA: AN OVERVIEW.
Centro para le Investigacion en Recursos Acuaticos de Nicaragua, Managua.
S. Montenegro-Guillen.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1155-1157, March 1991. 2 fig, 1 tab, 6 ref.

Descriptors: *Graben lakes, *Industrial wastes, *Ion concentrations, *Lake Managua, *Limnology, *Nicaragua, *Path of pollutants, *Water pollution sources, Aquatic plants, Copepods, Ecosystems, Fish, Microbiological studies, Oxygen requirements, Phytoplankton, Primary productivity, Rotifers, Seasonal distribution, Sodium bicarbonate, Spatial distribution, Turbidity, Vertical distribution, Volcanoes, Water chemistry, Wind effects, Zooplankton.

Lake Xolotlan or Managua is a graben lake, which evolved from the Nicaraguan rift valley together with Lake Nicaragua. About 300 small industries discharge their effluents containing mercury, lead, other heavy metals and pollutants. Lake Xolotlan is subject to considerable volcanic activity, some of which is used for geothermal energy generation. Wastes of this activity as well as hot springs rich in arsenic salts, boron and other substances also discharge into the lake. A research program for the lake included field sampling activities, laboratory analyses, data processing and scientific reports on phytoplankton, phytobenthos, zooplankton, zoobenthos, fish, chemistry and microbiology. The sampling was done monthly at 11 stations to examine seasonal trends. The results suggest a noticeable horizontal and vertical homogeneity in Lake Xolotlan produced by steady wind action which causes polymixis. High ionic content and sodium bicarbonate conditions are general features of the lake. Turbidity is high and phytoplankton biomass can account for up to 50% of this turbidity. In spite of the heavy organic input the almost constant wind action keeps the water column well-oxygenated. Primary production is also seasonally and spatially constant and very high. The lake has 20 zooplankton species. Copepod biomass is higher (80.8%) than that of other groups. Rotifers are more abundant in zones enriched with organic particles. Cladocerans are always in low densities. Maximum dry weight biomass is reached during the dry season, when phytoplankton biomass is also at a maximum. Zoobenthos is represented by 74 species in the littoral, with chironomids dominant. Mercury pollution is serious in Lake Xolotlan. Edible fish show dangerous levels for human consumption. The ecological situation of Lake Xolotlan poses important health hazards for Managuan populations. (Brunone-PTT)
W91-12755

PHYTOPLANKTON STUDIES IN A TROPICAL LAKE (LAKE XOLOTLAN, NICARAGUA).
Centro para le Investigacion en Recursos Acuaticos de Nicaragua, Managua.
E. L. Hooker, S. Hernandez, N. Chow, and L. Vargas.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1158-1162, March 1991. 2 fig, 1 tab, 15 ref.

Descriptors: *Algae, *Lake Managua, *Limnology, *Nicaragua, *Phytoplankton, *Rainfall, *Species diversity, *Tropical regions, *Water pollution effects, *Wind effects, Biomass, Chlorophyta, Diatoms, Nutrient concentrations, Population density, Population dynamics, Seasonal variation, Species composition, Transparency.

Lake Xolotlan (Lake Managua), in Nicaragua, is affected by wind action and rains, while its phytoplankton seasonality and abundance is deeply affected by nutrient supply and water transparency. A comprehensive program including measurements of algal primary production was initiated in 1986 at the Research Center for Aquatic Resources of Nicaragua to study the lake. Phytoplankton samples were collected monthly between July 1986 and May 1987. One hundred and twenty-two taxa were recorded in Lake Xolotlan, about half belonging to Chlorophyta. The phytoplankton assemblage of Lake Xolotlan is similar to other tropical lakes. Biomass was dominated by blue-greens (53% of total phytoplankton biomass). Diatoms made up 35% and chlorophytes 12%. Diatoms were most abundant during the dry season when wind velocities were higher, favoring vertical mixing and reduces algal losses from the productive zone favoring the development of the diatom Nitzschia acicularis. Chlorophyta showed the major diversity with about 50% of the total number of species, although the total biomass of the lake was less important, excepting for a short period when Oocystis reached high population densities. The species composition of the phytoplankton community is quite stable and is homogeneously distributed throughout the lake. Total algal biomass in Lake Xolotlan is high (14.5 mg/L FW +/-5.26). Sewage water from the city of Managua (1,000,000 people and phosphorus loading estimated in 1 to 2 g/sq m/year) and this polymixis contributes to this high biomass. Phytoplankton biomass in the lake is also strongly influenced by increased runoff during the wet season, which causes a high input of water altering the lake volume. (Brunone-PTT)
W91-12756

DYNAMICS OF PHOTOSYNTHETIC ACTIVITY IN LAKE XOLOTLAN (NICARAGUA).
Centro para le Investigacion en Recursos Acuaticos de Nicaragua, Managua.
R. Erikson, E. Hooker, and M. Mejia.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1163-1166, March 1991. 3 fig, 7 ref.

Descriptors: *Eutrophic lakes, *Lake Managua, *Limnology, *Nicaragua, *Photosynthesis, *Tropical regions, *Water pollution effects, *Water temperature, Annual distribution, Organic matter, Path of pollutants, Rainfall, Respiration, Seasonal variation, Wastewater pollution, Water depth.

Lake Xolotlan (Lake Managua), in Nicaragua, is a tropical shallow lake, warm and eutrophic, and can be used to test the hypothesis that photosynthetic capacity appears to be a function of temperature. During an annual cycle, the photosynthetic activity was measured in situ every second or third month at eight different sampling sites, using the light and dark bottle technique and Winkler analysis. The annual average of hourly rates of gross photosynthetic activity per unit area during 1985 to 1986 was 1860 mg O2/sq m/hour. The mean hourly rate of gross photosynthetic activity during the following years was 2230 mg O2/sq m/hour. The photosynthetic activity at optimum depth had an annual average during 1985 to 1986 of 2300 mg O2/sq m/hour. The photosynthetic activity in Lake Xolotlan is characterized by a spatial and seasonal stability. The dry season is more windy than the rainy season, but the dilution-concentration effects of a changing water volume, as a determining factor for this dynamic, is indicated by the results from measurements at the end of the dry season, 1989. The water level than was still high because of heavy rains in October the previous year. The estimations of a total community respiration of 19 to 24 g O2/sq m/day indicate that Lake Xolotlan is a heterotrophic system, probably as a result of a large input of organic matter from untreated sewage permanently entering the lake and high planktonic respiration losses. (Brunone-PTT)
W91-12757

ZOOPLANKTON STUDIES IN A TROPICAL LAKE (LAKE XOLOTLAN, NICARAGUA).
R. O. Cisneros, and E. I. Mangas.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1167-1170, March

1991. 3 fig, 2 tab, 16 ref.

Descriptors: *Copepods, *Lake Managua, *Limnology, *Nicaragua, *Population dynamics, *Rotifers, *Species composition, *Tropical regions, *Waterfleas, *Zooplankton, Animal physiology, Biological sampling, Biomass, Nutrient concentrations, Population density, Rainfall, Seasonal variation, Species diversity, Water pollution effects.

As part of an integrative approach to the zooplankton ecology in Lake Xolotlan (Lake Managua), in Nicaragua, taxonomy, population and biomass fluctuations were analyzed. Samples were taken monthly at eleven stations from 1985 to 1987, collected with a zooplankton net and with the Schindler sampler from 1 m above the bottom to the surface. Community diversity was calculated by means of the Shannon-Wiener index, while the Sorenson index was used to establish similarities between zooplankton assemblages from several lakes. Lake Xolotlan has twelve species of rotifers, two species of cladocerans, and four species of copepods. The diversity of the zooplankton community of Lake Xolotlan is similar to that found in other tropical lakes under environmental stress and lower than less impacted, tropical waterbodies, such as ria lakes. Zooplankton population densities for the major groups in Lake Xolotlan were rotifers, 50 to 858 individuals/L; copepods, 15 to 240 individuals/L; and cladocerans 0 to 36 individuals/L. Population trends for rotifers were variable. Copepods had the highest population densities during the rainy period and a minimum during the dry season. Cladoceran fluctuations were also similar although with less pronounced peaks. Rain enhances nutrient loading and phytoplankton growth which in turn is the main food source for some cladocerans and copepods. Rotifer biomass was up to four times higher at the southern basin where organic pollution is more intense, but copepod and cladoceran biomass showed no differences. (Brunone-PTT)
W91-12758

HETEROTROPHIC ACTIVITY AND BACTERIAL GROWTH IN A TROPICAL LAKE (LAKE XOLOTLAN, MANAGUA, NICARAGUA).
Centro para le Investigacion en Recursos Acuaticos de Nicaragua, Managua.
K. Vammen, R. Erikson, M. H. Vargas, and R. Bell.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1171-1173, March 1991. 3 fig, 14 ref.

Descriptors: *Bacterial growth, *Heterotrophic bacteria, *Lake Managua, *Limnology, *Nicaragua, *Tropical regions, *Water pollution effects, Cycling nutrients, Decomposition, Organic matter, Primary productivity, Sedimentation, Thymidine incorporation, Water sampling.

Lake Xolotlan (Lake Managua), is a shallow polymictic tropical lake, appearing to be strongly dominated by primary producers and decomposers. The lake also receives a heavy load of organic matter with the sewage from the city of Managua. The decomposition and mineralization of organic matter from microbial activity can play a key role in Lake Xolotlan's total metabolism. Tritiated thymidine incorporation was consistently high in the four monthly sampling dates of the rainy season averaging 91 pmol/L/hour at station 1 and 65 pmol/L/hour at station 7. The bacterial production varied almost three-fold in the four morning sampling dates at station 7 in October due to the influence of the wind on sediments. Thymidine incorporation varied by a factor of 3 during the 24 hour diurnal sampling. Bacterial production (thymidine incorporation converted to units of carbon) averaged approximately 840 mg C/sq m/day in Lake Xolotlan. In a recent evaluation of temperate lakes the highest production reported was 580 mg C/sq m/day. This high areal production of Lake Xolotlan may be partly due to the polymictic character of the lake and other properties of tropical lakes in general, like constant high temperature, efficient nutrient cycling, and also by high and constant organic loading from the city of Managua. (Brunone-PTT)
W91-12759

DEMOGRAPHIC ANALYSIS OF TROPICAL ZOOPLANKTON POPULATIONS.
Rhode Island Univ., Kingston. Dept. of Zoology.
S. Twombly, and H. Caswell.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1183-1187, March 1991. 3 fig, 14 ref. NSF Grants BSR-8609395, BSJ-8315410, BSR-8604655.

Descriptors: *Copepods, *Limnology, *Model studies, *Population dynamics, *Venezuela, *Waterfleas, *Zooplankton, Biological samples, Estimating, Laguna la Orsinera, Mathematical models, Mortality, Phytoplankton, Recruitment, Time series analysis, Water temperature.

A demographic estimation procedure, based on matrix models for complex life cycles, was used to estimate the dynamics of a tropical copepod population in a Venezuelan floodplain lake, Laguna la Orsinera. The three copepod species (Diaptomus negrensis, Rhacodiaptomus calatus, Oithona amazonica) increased in abundance sequentially over the sampling period: peak population size for Diaptomus negrensis occurred in July/August as the laguna was filling, Rhacodiaptomus calatus peaked in October during the drainage phase, and Oithona amazonica peaked in late October/November after the laguna had become separated from the Orinoco River. Growth rates of each stage varied little throughout the study. Temperature changed little during this period, and growth rates appeared little affected by changes in phytoplankton abundance that accompanied inundation and drainage. Survival of all stages was high during inundation, but decreased as the laguna drained in September. Traditional estimation procedures yield average growth and mortality rates for each developmental stage. Determination of D. negrensis population size by recruitment and survivorship contrasts with factors influencing cladoceran population sizes in the lake. Cladoceran population sizes were determined by high mortality rates rather than by fluctuation in recruitment. Thus, the environmental and demographic processes controlling population sizes differ between species groups of zooplankton, as well as between species within a species group. Time series of demographic estimates can be used to understand how individual populations within one lake respond to short-term environmental change and to compare factors affecting population dynamics between lakes. (Brunone-PTT)
W91-12762

PHOTOSYNTHETIC PARAMETERS FOR PHYTOPLANKTON IN AMAZON FLOODPLAIN LAKES, APRIL-MAY 1987.
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil). Dept. of Ecology.
B. R. Forsberg, T. P. Pimentel, and A. D. Nobre.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1188-1191, March 1991. 3 fig, 1 tab, 15 ref.

Descriptors: *Amazon River, *Flood plains, *Limnology, *Photosynthesis, *Phytoplankton, Brazil, Chlorophyll, Light intensity, Mathematical models, Respiration, Rising stage, Statistical analysis.

The variability of phytoplanktonic photosynthetic parameters was analyzed among Amazon floodplain lakes during the rising water period (April to May) of 1987. Fifteen lakes were sampled along the central floodplain of the Amazon river between Santo Antonio de Ica and Obidos, a distance of approximately 1500 km. Depth profiles were determined at a depth of 0.5 m. Inhibition was often observed at the highest light intensities; these data points were always excluded from statistical analysis. A strong positive correlation existed between the chlorophyll specific light saturated rate of photosynthesis and the initial slope of the P vs I curve. Chlorophyll concentrations also varied considerably between lakes as did community respiration (R) rates, and the non-normalized photosynthetic parameters (the light-saturated rate of photosynthesis (Pm) and initial slope of the non-normalized P vs. I curve (alpha)). The Pm:R ratio ranged between 2.0 and 12.2 with an average value of 5.2. The high variability of Pm and alpha hinder the application of numerical photosynthesis models to estimate integral production rates from remotely sensed chlorophyll and extinction data. (Brunone-PTT)
W91-12763

CHEMICAL STUDIES ON SEDIMENTS IN THE RIO DOCE VALLEY LAKES, BRAZIL.
Aichi Univ., Toyohashi (Japan). Faculty of Liberal Arts.
Y. Saijo, O. Mitamura, and F. A. R. Barbosa.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p , March 1991.

Descriptors: *Brazil, *Lake Amarela, *Lake Carioca, *Lake Dom Helvecio, *Lake Jacare, *Lake sediments, *Limnology, *Sediment chemistry, Environmental effects, Eucalyptus trees, Nitrogen, Organic carbon, Phosphorus, Rio Doce Valley, Sediment sampling, Sedimentation, Soil erosion.

Determination of organic carbon, nitrogen and phosphorus in Rio Doce Valley Lakes in Brazil were made for sediment trap samples as well as for core samples of bottom sediments taken at four lakes (Lake Dom Helvecio, Lake Carioca, Lake Jacare, and Lake Amarela). On average, lower sedimentation rates were observed in Lake Dom Helvecio, the deepest lake and the higher rates in Lake Carioca, a shallower lake in natural forest. Higher sedimentation rates were generally observed in Lake Jacare and in Lake Amarela, in lakes of the eucalyptus forest, probably caused by the high soil erosion rates due to the cutting of the trees every eight to ten years and the poor growth of underbush. The higher values of carbon and nitrogen contents were generally found in Lake Carioca, while lower values were noted in Lakes Dom Helvecio and Jacare. The water content in the sediments was generally very high, 94 to 96% at the surface. Loss on ignition was generally high in four lakes, namely in Lake Dom Helvecio, 27 to 33%; Lake Carioca, 45 to 58%; Lake Jacare, 32 to 46%; and Lake Amarela, 22 to 45%. The high water content and organic matter content is noteworthy, compared with Japanese lakes or other lakes in the temperate region. The vertical distribution of chemical constituents in Lake Jacare and Lake Amarela showed patterns suggesting changes in lake environment. In Lake Jacare, the decrease in organic matter content in the upper layer of the sediments may be explained by an increase of inorganic substances supplied by soil erosion, while in Lake Amarela, the decrease may be caused by a supply of allochthonous substances in some weather conditions. (Brunone-PTT)
W91-12764

EMPIRICAL RELATIONSHIPS BETWEEN NUTRIENTS, PHYTO- AND ZOOPLANKTON AND RELATIVE FISH BIOMASS IN LAKES AND RESERVOIRS OF ARGENTINA.
Instituto Nacional de Investigacion y Desarrollo Pesquero, Mar del Plata (Argentina).
R. Quiros.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1198-1206, March 1991. 3 fig, 3 tab, 44 ref. Consejo Nacional de Investigaciones Cientificas y Tecnicas Grant PID 3-017400/85.

Descriptors: *Argentina, *Fish populations, *Limnology, *Nutrients, *Zooplankton, Biomass, Lakes, Regression analysis, Reservoirs, Trophic level.

Relationships between nutrients, chlorophyll, microzooplankton and macrozooplankton biomass, and relative fish biomass were evaluated for 110 lakes and reservoirs located throughout the central-western and northwestern arid regions of Argentina. Lakes with and without the zooplanktivorous fish Basilichthys bonariensis and B. microlepidotus, of the silverside family (Atherinidae), were compared. Most of the reservoir fish species

have been introduced from outside Argentina or from other Argentine river basins. Lakes were classified according to the presence of fish or degree of human intervention. Phytoplankton, microzooplankton and macrozooplankton, and total fish standing stocks were highly correlated with each other and also with climatic, morphometric and nutrient-related variables. After Secchi depth, total phosphorus was the second strongest estimator of chlorophyll, as well as sites with and without atherinids. Regression analysis indicated that total fish standing stock was more related to total phosphorus than to any other variable considered. No significant differences were noted between lakes and reservoirs, or between mixed and stratified lakes. Microzooplankton and macrozooplankton biomass increased with lake trophic level. Regression slopes for macrozooplankton/microzooplankton relationships were significantly different for lakes with and without atherinids. (Brunone-PTT)
W91-12765

PRODUCTIVITY AND HETEROTROPHIC ACTIVITIES IN WARM AND TEMPERATE LAKES.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Oekophysiologie.
H. Rai.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1207-1211, March 1991. 4 fig, 2 tab, 16 ref.

Descriptors: *Amazon River, *Amazon River Basin, *Heterotrophic bacteria, *Limnology, *Primary productivity, *Rainfall intensity, *Temperate zone, *Trophical regions, *Tropical areas, Aquatic plants, Chlorophyll a, Nutrient concentrations, Phosphates, Turnover time, Vegetation, Water level, Water temperature.

The warm lakes of the Central Amazonian region are created by fluvial action and are subject to heavy rains and small temperature variations. They are moderately stratified during the day at the low water period. In temperate aquatic ecosystems heterotrophic activity is perhaps dependent on a combination of psychrophils and mesophils and ranges from 0.007 microg/L/hour to 15.0 microg/L/hour. Bacterial activity in the warm lakes, most likely due entirely to mesophils, ranged from 0.039 to 79 microg/L/hour. Turnover times ranged from 12 to 36,000 hours. Bacterial numbers varied from a low of 28,000,000 in Lago Tupe to a high of 1,700,000,000 in Lago Januari. Patterns of heterotrophic activity in these warm lakes are predominantly an expression of primary productivity. The lakes exhibited a seasonal trend in bacterial activity that peaked during the low water period. Increases in chlorophyll a seem to be associated with the developing increases in Vmax. Floating meadows are stranded on the shore under low water conditions where they undergo active microbial decomposition. Further in Lago Januari, variations in lake depth can account for 81% of the variability of chlorophyll a which, in turn, exerts influences on the heterotrophs. Highest values of Vmax in Lago Tupe occurred concomitantly with highest chlorophyll a, lowest phosphate, and low water levels. Similar patterns of uptake kinetics for heterotrophs are reported for temperate lakes. Average net primary production appears to control the range of Vmax in aquatic systems in various climatic zones. Surface ranges were considerably greater in the blackwater lakes than in the mixed or whitewater lakes. In conclusion, the patterns of Vmax exhibited in warm lakes of Central Amazonia were established as a result of water levels, nutrients, primary production, and natural substrate levels. (Brunone-PTT)
W91-12766

ABUNDANCE AND ACTIVITY OF BACTERIOPLANKTON IN WARM LAKES.
Instituto de Ciencias del Mar, Barcelona (Spain).
C. Pedros-Alio, and R. Guerrero.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1212-1219, March 1991. 4 fig, 35 ref.

Descriptors: *Analytical methods, *Bacterioplankton, *Limnology, *Primary productivity, *Warm lakes, Cell counting, Microscopic analysis, Population density, Separation techniques, Water temperature.

Even though little information is available on bacterioplankton from warm lakes, no intrinsic differences exist between warm and cold lakes exist as far as abundance and activity are concerned. A satisfactory technique for counting total bacterial numbers in the field was established about fifteen years ago, consisting of epifluorescence microscopy of stained aliquots filtered on 0.2 microm Nucleopore filters. Total counts are available for a large number of aquatic systems under different conditions, including seasonal and vertical distributions. No satisfactory technique exists to measure bacterioplankton production. A good correlation exists between bacterial heterotrophic production and primary production regardless of the technique used or the systems studied. However, nothing is known about species composition. The extraordinary diversity of lakes in the warm belt suggests that more attention should be devoted to such systems before results from dimictic lakes are generalized to all aquatic habitats. The richness of the biology of warm lakes makes such a prospect an exciting challenge. (Brunone-PTT)
W91-12767

SURVEY OF ALGAL PICOPLANKTON FROM LAKES IN FIVE CONTINENTS.
Durham Univ. (England). Dept. of Biological Sciences.
G. R. W. Hawley, and B. A. Whitton.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1220-1222, March 1991. 1 fig, 2 tab, 9 ref. NERC Studentship GT 4/86/ALS/13.

Descriptors: *Biological sampling, *Laboratory methods, *Limnology, *Microscopy, *Picoplankton, *Sample preservation, *Standing waters, Comparison studies, Population density, Seasonal distribution.

A preservation method, using formalin or glutaraldehyde as a preservative, was developed for picoplankton, which was used for samples from a wide range of standing waters. The method was also tested for minimum and maximum population densities of picoplankton in four English lakes to determine fluctuations over a twelve-month period. Picoplankton were enumerated using epifluorescence microscopy. Monthly samples for the seasonal cycles were taken from four English lakes (Ennerdale, Wastwater, Malham Tarn and Cassop Pond) at a depth of 1 m, fixed with 2% formalin and stored in the dark. The preservation data show that samples can be preserved for long-term storage of picoplankton without noticeable deterioration of the fluorescent properties of their pigments. Samples from five continents suggest that picoplankton may be ubiquitous; in every standing body of water there were at least 100 picoplankton cells/ml. Direct comparison of densities from lakes sampled at different times of the year is not possible, as densities range within any one lake over approximately two orders of magnitude. However, the range of pico-plankton exhibited by the twenty countries (102 to 1,200,000 cells/ml) is outside the range of the seasonal cycles in any of the UK lakes. (Brunone-PTT)
W91-12768

SPECIES RICHNESS OF CRUSTACEAN ZOOPLANKTON IN EUROPEAN LAKES OF DIFFERENT SIZES.
Wisconsin Univ., Madison. Dept. of Zoology.
S. Dodson.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1223-1229, March 1991. 2 fig, 3 tab, 51 ref. NSF Grant BSR-8805805.

Descriptors: *Crustaceans, *Lake morphometry, *Limnology, *Photosynthesis, *Regression analysis, *Species richness, *Zooplankton, Furuskar Rock Pool, Great Lakes, Lake Baikal.

Regression analysis was used to investigate relationships between species richness of crustacean zooplankton and morphology and productivity of lakes. Lakes were chosen for analysis if the lake morphometry and an estimate of the annual amount of photosynthesis using the carbon-14 technique were available, and if zooplankton were sampled more than once. The number of crustacean zooplankton species and lake size are significantly correlated (log-log regression, n = 32, r squared = 0.33). The lakes range in size from Furuskar Rock Pool (4 species, 6 sq m surface area) to Lake Baikal (26 species and 31,500,000,000 sq m). The regression has an unusually low slope (z=0.051), which may indicate a high immigration rate. Depth and volume are nearly as strongly correlated with species richness as area. Species richness is not correlated with latitude or longitude. Species richness and photosynthetic flux are each inversely correlated with elevation and directly correlated with specific conductance. Variations in species richness not explained by the species-area curve is a parabolic-like function of average photosynthetic flux (0.45 to 187 mg C fixed/cu m/day, r squared = 0.29, n = 21, excluding Lake Baikal). Lake Baikal, like the Laurentian Great Lakes, has more zooplankton species than predicted by photosynthetic flux. For lakes smaller than Baikal, about 60% of the variation in species richness is explained by lake size and volumetric photosynthetic rate. The species-energy curve suggests a trophic classification of lakes. (Brunone-PTT)
W91-12769

PHYTOPLANKTON COMPOSITION AND ACTIVITY IN LAKES OF THE WARM BELT.
Kinneret Limnological Lab., Tiberias (Israel).
U. Pollingher, and T. Berman.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1230-1234, March 1991. 3 tab, 13 ref.

Descriptors: *Algae, *Limnology, *Mountain lakes, *Phytoplankton, *Species composition, *Species diversity, *Tropical, Altitude, Chlorophyta, Comparison studies, Cyanophyta, Diatoms, Photosynthesis, Temperate zone.

Major differences in phytoplankton assemblages between lakes of the warm belt and those of other regions were hypothesized to be seen only in large and deep lakes. Most phytoplanktonic algae are cosmopolitan and appear to be well-adapted to warm belt, temperate or other lakes. The phytoplankton of the large warm belt lakes is a mixture of these and some more specific tropical forms. In the small water bodies at low latitude, the tropical species are still present, but in the high mountain lakes, these elements nearly disappear. Tropical species appear among the Cyanophyta (Anabaenopsis, Lyngbya, Oscillatoria), diatoms (Melosira, Nitzschia, Surirella) and desmids (Staurastrum). Some of them are considered endemic species. The old Lake Titicaca does not contain endemic species, but a new species of Cyclotella was described and some rare ulotrichals are present. In tropical lakes at low altitude, the photosynthetic activity of the phytoplankton is higher and its renewal time is shorter than in temperate lakes. As a general rule, the differences between phytoplankton composition in tropical and temperate lakes are more evident in large ones (>500 sq km surface area), decrease in medium-sized lakes, and nearly disappear in small water bodies located at high elevation. (Brunone-PTT)
W91-12770

UTILITY OF LATITUDE AND OTHER ENVIRONMENTAL FACTORS AS PREDICTORS OF NUTRIENTS, BIOMASS AND PRODUCTION IN LAKES WORLDWIDE: PROBLEMS AND ALTERNATIVES.
McGill Univ., Montreal (Quebec). Dept. of Biology.
J. Kalff.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1235-1239, March

1991. 7 fig, 12 ref.

Descriptors: *Algae, *Biomass, *Lake classification, *Latitudinal studies, *Limnology, *Nutrient concentrations, *Phosphorus, *Phytoplankton, *Zooplankton, Chlorophyll a, Fish populations, Mathematical models, Prediction, Primary productivity, Regression analysis, Spatial distribution, Statistical analysis, Water depth.

Warm and cool freshwater lakes were compared to test if they differed systematically in selected limnological attributes on an annual basis. Data for total phosphorus, algal biomass as chlorophyll a, zooplankton biomass, phytoplankton primary production and fish yield were collected and subjected to statistical analysis. Regressions of latitude on lake attributes were determined after a logarithmic transformation of all the data, other than latitude, to help normalize their distribution and stabilize the variance. An absence of a significant annual relationship was noted between latitude, a surrogate for annual mean water temperature, phytoplankton as chlorophyll a and zooplankton biomass, whereas total phosphorus increased significantly with decreasing latitude. An increase in annual phytoplankton production and fish yield with declining latitude was attributed to the increase in the length of the growing season, which is particularly pronounced between the arctic and temperate zones. Individually, latitude, total phosphorus and mean depth explain a quarter of the variation in primary production and fish yield worldwide and thus lack predictive utility, as does the morphoedaphic index. Multivariate models do not appear to be much better globally. Even if global models have little practical utility, simple regional models with utility can be developed to resolve problems of a regional nature. A comparison and integration of the regional patterns of lake functioning will do much more for the development of limnology than a focus on whether lakes are warm or cool. (Brunone-PTT)
W91-12771

PALEOLIMNOLOGY AND HINDCASTING CLIMATIC TRENDS.
Queen's Univ., Kingston (Ontario). Dept. of Biology.
J. P. Smol, I. R. Walker, and P. R. Leavitt.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1240-1246, March 1991. 48 ref.

Descriptors: *Climatic changes, *Global warming, *Limnology, *Paleoclimatology, *Paleolimnology, *Species composition, Chronostratigraphy, Hydrologic models, Palynology, Polar lakes, Pollen records, Prediction, Saline lakes.

Paleolimnological research, based on morphological and biogeochemical remains of aquatic assemblages, provides excellent research opportunities that could be applied to the study of climatic change and its effects. The proxy record available from paleolimnological studies will greatly supplement data obtained from other sources, and may prove a more sensitive indicator of climatic change. Although palynologists have chronostratigraphic control equal to that of paleolimnologists, the danger of local pollen records being contaminated via long-distance transport, and the possibility of long time-lags between climatic change and terrestrial vegetation response, are not significant problems to paleolimnological inferences, which use autochthonous indicators with high turnover rates. Limnologists working with present-day systems can contribute greatly to the resolution of these studies. Paleolimnologists require much more information on the autecology of indicator organisms. Limnologists can also contribute to the study of climatically sensitive lakes, particularly saline lakes, polar lakes and lakes along ecotonal boundaries. The climatic proxy data will provide a valuable verification of other interpretations. The rapid climatic changes at the close of the last glaciation may be the best available analogues for the present global warming. Therefore, the accuracy of predictions of new circulation models, developed from an understanding of present climate, can best be tested using information from past climatic regimes. (Brunone-PTT)
W91-12772

PHOTOTROPHIC PIGMENTS AND MINERAL PHASES RECORDING EARLY ENVIRONMENTAL SIGNALS.
Heidelberg Univ. (Germany, F.R.). Inst. fuer Sedimentforschung.
S. Neukirch.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1247-1249, March 1991. 3 fig, 2 ref.

Descriptors: *Algal populations, *Bacteria, *Bioindicators, *Eutrophication, *History, *Lake Constance, *Lake sediments, *Limnology, *Minerals, *Pigments, *Population dynamics, Aerobic conditions, Anoxic conditions, Carotenoids, Chlorophyll a, Cyanophyta, Diatoms, Industrialization, Primary productivity, Pyrrophyta, Sediment analysis.

Reconstruction of eutrophication can be indicated by changing algal and bacterial populations which have adapted to environmental conditions. Mineral associations indicate input variations with possible effects on the amount of nutrients. Samples with a depth of +/-550 cm contain very small quantities of carotenoids, chlorophyll a and phaeophytines, degradation products of chlorophyll a as indicators of bioproduction. The plot of the mineral phases shows a dramatic increase of calcite up to values higher than in recent material. Analysis of this and other cores of Lake Constance show various changes in the state of eutrophication. The deepest signal consists of small primary production with a high level of cyanophytes, indicating an extremely anoxic situation and a drastic increase of authigenic inorganic calcite, possibly caused by an increased temperature during the interglacial period. The younger signal has a peak of primary production along with the occurrence of Pyrrophyta and special diatoms as indicators of increasing eutrophication and conditions are less anoxic. In recent material, signals of strong eutrophication caused by industrialization are found: dramatically prograding bioproduction and high amounts of biogenic and inorganic calcite. Nevertheless, the lake seems to have undergone a stage of more anoxic conditions than at present. (Brunone-PTT)
W91-12773

GRAIN SIZE VARIATIONS AND ITS PERIODICITIES IN PLEISTOCENE SEDIMENTS FROM LAKE BIWA, JAPAN.
Osaka Electro-Communication Univ. (Japan). Dept. of Physics.
A. Yamamoto, K. Kashiwaya, K. Fukuyama, and H. Taishi.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1250-1253, March 1991. 3 fig, 1 tab, 12 ref.

Descriptors: *Climatic changes, *Japan, *Lake Biwa, *Lake sediments, *Paleoclimatology, *Paleolimnology, *Particle size, *Periodicity, *Pleistocene sediments, *Sedimentation, Precipitation, Sediment sampling.

Lake Biwa, in the central area of Japan, is one of the oldest lakes in the world. In the central part of the lake, two cores of 200 m and 1422 m were taken in 1971 and 1982 to 1983, respectively. The 1400 m core is biologically divided into 5 members of P to T beds. In the time series of grain size parameters in the R-layer, dominant periods of about 20,000 and 40,000 ys, and about 30,000, 70,000 and 130,000 to 140,000 ys were detected. These periodicities are in agreement with those for the T-layer, as well as the 200 m core. These periodicities suggest that grain size variations might reflect climatic change, especially precipitation change. Early Lake Biwa is estimated to have been formed about 2.16 Ma, and lasted 0.5 Ma up to 1.66 Ma. (Brunone-PTT)
W91-12774

CONTINUOUS FLOW-SYSTEM TO MEASURE PHYTOPLANKTON PHOTOSYNTHESIS.
Roskilde Universitetscenter (Denmark). Inst. of Life Sciences and Chemistry.
For primary bibliographic entry see Field 7B.
W91-12776

C-14 UPTAKE AND GROWTH RATE OF PHYTOPLANKTON IN CONTINUOUS CULTURES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 7B.
W91-12777

DISCREPANCIES BETWEEN O2- AND 14C-METHOD RESULTING FROM MEASUREMENTS OF PRIMARY PRODUCTION UNDER CONSIDERATION OF VERTICAL MIXING IN A SHALLOW EUTROPHIC LAKE.
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
B. Nixdorf, and H. Behrendt.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1268-1271, March 1991. 1 fig, 1 tab, 24 ref.

Descriptors: *Algal growth, *Carbon radioisotopes, *Eutrophic lakes, *Experimental design, *Limnology, *Primary productivity, *Turbulence, *Vertical distribution, *Mixing, *Water analysis, Cyanophyta, Light effects, Muggelsee, Oxygen requirements, Polymictic lakes.

The importance of turbulence-induced mixing for algal development was investigated by studying the effects of light-dark changes on productivity. The investigations of primary production were carried out in Lake Muggelsee, a eutrophic polymictic shallow lakes. In general, primary production in cycled bottles was increased in a range of periods between 6 and 30 minutes, corresponding to 2 to 10 cycles/hour, which was used for routine measurements. Turbulence-induced mixing enhanced integral primary production. Oxygen net community production is significantly increased due to elimination of photoinhibition, during incubation in the afternoon and dominance of blue-green algae. Furthermore, the oxygen method shows an adaptation to simulated periods between 6 and 30 minutes indicating a long-term acquired preference to turbulence. Carbon-14 results were not influenced during short-term incubation with the exception of dominance of blue-green algae. The carbon-14 technique is a measure of gross carbon incorporation, which is only weakly influenced by light-dependent losses. The applicability of these results from a highly eutrophic shallow lake to other ecosystems needs to be proven and more information is required about algal movements due to turbulence. (Brunone-PTT)
W91-12778

IMPROVEMENT IN ACCURACY OF THE INTERPRETATION OF ALGAL GROWTH CURVES USING A 200 CHANNEL AUTOMATIC BATCH CULTURE APPARATUS.
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
B. van der Veer, G. Bolier, H. van Dijk, and M. Donze.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1272-1276, March 1991. 5 fig, 1 tab, 17 ref.

Descriptors: *Algal growth, *Bioassay, *Culturing techniques, *Limnology, *Testing procedures, *Toxicity, Growth curves, Laboratory equipment, Metals.

Laboratory measurements of growth curves of microorganisms in batch cultures are a tool that is used in several kinds of investigations. Different phases can be measured by the duration and by the slope of the growth curve. An automatic batch culture apparatus was developed to measure complete growth curves with sufficient accuracy and time resolution of measurement to supply the data at a labor cost about equivalent to that of single point toxicity tests. Cultures are aerated with filter sterilized compressed air. The algae used are cul-

tured on artificial media. The effect of a stressor can be an increase in the lag phase, a decrease in exponential growth rate, a decrease in the maximal yield or any combination of these. The new apparatus enables measurement with high frequency and enables working in manifold, without as many restrictions of time and price. Preparing and running a test with 200 cultures is about 2 days work for 1 technician. The automatic reduction and handling of data is under development. (Brunone-PTT)
W91-12779

ALGAL-CONSUMER INTERACTIONS IN 2-STAGE CONTINUOUS CULTURE SYSTEMS.
Michigan Univ., Ann Arbor. Dept. of Biology.
S. S. Kilham, and R. L. Kiesling.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1277-1280, March 1991. 3 fig, 9 ref.

Descriptors: *Algae, *Chlorophyta, *Culturing techniques, *Diatoms, *Laboratory methods, *Limiting nutrients, *Limnology, *Population dynamics, *Protozoans, Competition, Mortality, Phosphorus, Silicon.

A two stage continuous culture system was used to investigate the impact of two different consumers on the population dynamics of two algal species, the diatom Synedra ostenfeldii (80 to 100 microm length) and the green alga Chlamydomonas (6 to 8 mm diameter). Only the two algae grew in the first stage cultures (350 ml) with continuous outflow (100 ml/day) to second stage cultures. Only silicon or phosphorus were potentially limiting nutrients, added at various levels. The diatom was either unlimited or silica-limited and the green alga was phosphorus-limited. The second stage (700 ml) had a constant inflow and the outflow was once per day. Animals were added to half of the second stage cultures. With the cladoceran Daphnia pulicaria as consumer, Chlamydomonas was eaten and Synedra was unaffected. In the accompanying stage-two control cultures, the two species coexisted, with Chlamydomonas being phosphorus-limited and Synedra being unlimited and growing exponentially during one case, and silica-limited in the other case. In another set of experiments, the protozoan Acanthocystis was the consumer. Synedra was unaffected. In the accompanying stage two control culture, the two species coexisted, with Synedra being silica-limited and Chlamydomonas being phosphorus-limited. Consumer-algal interactions can be complex and species-specific mortality can affect the interpretation of the outcome of competitive interactions. (Brunone-PTT)
W91-12780

ANNUAL VARIATIONS OF THE PHYTOPLANKTON COMMUNITY DURING IMPOUNDMENT OF CANADIAN SUBARCTIC RESERVOIRS.
Montreal Univ. (Quebec). Dept. of Biological Sciences.
B. Pinel-Alloul.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1282-1287, March 1991. 4 fig, 1 tab, 18 ref.

Descriptors: *Bioindicators, *James Bay, *Limnology, *Phytoplankton, *Quebec, *Reservoirs, *Subarctic zone, *Temperate zone, *Trophic level, Annual distribution, Canada, Chlorophyll, Chlorophyta, Chrysophyta, Cyanophyta, Diatoms, Nitrogen, Nutrient concentrations, Phosphorus, Productivity, Species composition, Succession, Water temperature.

Man-made subarctic reservoirs depart radically from natural north temperate lakes with respect to abiotic factors (winter drawdown, flow and temperature regimes, nutrient loading) and biotic factors (community structure, productivity and ecological succession). The completion of the hydroelectric project of the Complexe La Grande in the James Bay area, in Quebec, provided an opportunity to study the variations of the phytoplankton community of two subarctic reservoirs during the first two years of impoundment. The objectives of the study were (1) to describe the changes in the general structure and the species dominance after the impoundment; (2) to determine which species are indicators of trophic upsurge; and (3) to test whether observed differential structures and species abundance during impoundment were associated with variations in water quality and trophic factors. The mean annual total abundance and the general composition of the phytoplankton community during the first two years of impoundment were different in littoral and central zones. In general, a two-fold increase in total abundance was noted during the first two years of impoundment in the reservoir LG-2 and between the pre-impoundment and post-impoundment years in the reservoir Opinaca. In the new reservoir, monads were dominant, indicative of their heterotrophic capabilities. Other algal species are indicators of oligotrophic or mesotrophic lakes. Impoundment was related to an increase in total phosphorus, total nitrogen, chlorophyll a and phaeopigments. Total carbon decreased after impoundment. Most of the phytoplankton groups presented a positive relationship with trophic upsurge in nutrients, and with pigment increases. Increases in total organic carbon were associated with the development of pyrrophytes, cyanophytes, and chlorophytes, and inversely related to chrysophyte and diatom development. (Brunone-PTT)
W91-12781

TROPHIC ASSESSMENT OF A NEW RESERVOIR WITH EMPHASIS ON PHYTOPLANKTON PRODUCTIVITY.
William Paterson Coll. of New Jersey, Wayne. Dept. of Biology.
M. J. Sebetich, and J. Melcher.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1288-1293, March 1991. 8 fig, 2 tab, 12 ref.

Descriptors: *Baseline studies, *Chlorophyll a, *Limnology, *Monksville Reservoir, *New Jersey, *Phytoplankton, *Primary productivity, *Reservoirs, *Trophic level, *Wanaque Reservoir, Dissolved oxygen, Nutrient concentrations, Thermal stratification, Water resources management.

The trophic status of the Monksville and Wanaque Reservoirs, both located in northern New Jersey, were determined by measuring primary productivity and chlorophyll a concentrations, and baseline information on selected physico-chemical parameters was established for the Monksville Reservoir during the first year of impoundment. The Wanaque Reservoir was created in 1930; the Monksville Reservoir in 1987. Phytoplankton productivity was less in the Monksville Reservoir than in the Wanaque. Strong thermal stratification developed similarly in both reservoirs, and trophic indices were similar. Productivity in the Wanaque Reservoir could have been artificially increased by the influx of nutrient-enriched water that was diverted from the Pompton and Passaic Rivers during May and October 1988. The Monksville Reservoir is now being used for water storage, fishing and boating. The only unexpected results in the baseline studies were (1) the sharp summer decrease in dissolved oxygen in the metalimnion; and (2) the low chlorophyll a concentrations. Instability of plankton populations in the Monksville Reservoir appeared to reflect an ecosystem in transition from a former river to a new lacustrine environment. These results will be useful in future long term management of both reservoirs. (Brunone-PTT)
W91-12782

PHOSPHORUS, CHLOROPHYLL AND THE COMPARATIVE LIMNOLOGY OF THREE SUBURBAN LAKES IN NORTHERN VIRGINIA, U.S.A.
North Carolina State Univ., Raleigh. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W91-12783

SPATIAL VARIABILITY IN 14C ESTIMATES OF PHYTOPLANKTON PRODUCTIVITY IN KENTUCKY LAKE, AN IMPOUNDMENT OF THE TENNESSEE RIVER, U.S.A.
Murray State Univ., KY. Hancock Biological Station.
G. R. Marzolf, G. Cantrell, A. W. Groeger, K. Johnston, and G. T. Rice.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1300-1303, March 1991. 2 fig, 1 tab, 6 ref.

Descriptors: *Baseline studies, *Carbon radioisotopes, *Kentucky Lake, *Limnology, *Phytoplankton, *Primary productivity, *Reservoirs, *Tennessee River, *Water quality monitoring, Ammonia, Chlorides, Chlorophyll, Dissolved oxygen, Nitrates, Nitrites, Nitrogen, Photosynthesis, Population density, Sampling, Silica, Spatial variation, Water temperature.

A long-term study of biological processes in Kentucky Lake and the hydraulic and chemical variables that interact with them was started in 1988. Data was collected at 12 sites in Kentucky Lake between Tennessee River miles 37.0 and 54.7. Sites were chosen to provide for analysis of variation among the mouths of tributary embayments and the navigation channel. Parameters include (1) rate of photosynthesis by planktonic algae; (2) concentration of chlorophyll at 1 m, ammonia, nitrate plus nitrite, dissolved oxygen, nitrogen, total organic nitrogen, total phosphorus, silica and chloride at 1 m and 10 m above the bottom; (3) vertical profiles (at one m intervals) of temperature, dissolved oxygen concentration, oxidation-reduction potential, pH, and conductivity; and (4) population densities of phytoplankton and zooplankton. Spatial variation of photosynthesis in reservoirs is typically high due to the longitudinal pattern imposed by loading from the impounded river. The initial analysis of variance evaluated the difference among mean rates of photosynthesis at the mouth of embayments on the west side, the east side, and in the navigation channel. The radiocarbon uptake measurements are representative of potential in situ photosynthesis, but are not necessarily the same as the in situ rates. Phytoplankton photosynthesis varies laterally such that mean production rates at the mouths of tributary embayments often exceed production in the main body of the reservoir and the variance among these rates is high. Events associated with tributary embayments strongly influence primary production in the reservoir and they probably dominate dissolved nutrient loading from upstream reservoirs as a mechanism for establishing a production pattern in this 35 km reach of Kentucky Lake. (Brunone-PTT)
W91-12784

CONTRIBUTION OF MUDFLAT PRIMARY PRODUCTION TO A RESERVOIR CARBON BUDGET.
Mississippi Univ., University. Dept. of Biology.
N. G. Aumen, D. E. Miller, and C. L. Crist.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1304-1308, March 1991. 3 fig, 1 tab, 15 ref.

Descriptors: *Aquatic plants, *Carbon cycle, *Limnology, *Mississippi, *Mud flats, *Organic carbon, *Phytoplankton, *Primary productivity, *Reservoirs, *Sardis Reservoir, Biomass, Decomposition, Fiber analysis, Food chains, Landsat images, Remote sensing, Rivers, Water level.

The three major sources of particulate organic carbon (POC) to Sardis Reservoir, a large flood-control reservoir in north central Mississippi, are seston transported into the reservoir from numerous feeder streams and rivers, phytoplankton primary production within the reservoir, and primary production of vascular plants on mudflats exposed during reservoir drawdowns. To evaluate whether mudflat vegetation contributes significantly to the reservoir POC budget, remote sensing was used. The vegetation occurring on exposed mudflats was identified and quantified by standard techniques. Landsat images indicated an increase in area of exposed mudflats with decreasing water elevation. The images and water detention times suggest that

the hydrology of Sardis Reservoir is more riverine than lacustrine. Ground surveys conducted on exposed mudflats showed that a substantial portion of surface area was vegetated, particularly by grasses. The grasses were dominated by Polygonum hydropiperoides, which had an average biomass of 184 g C/sq m, representing 44% of the total plant biomass. Slow decomposition rates may have also been due to the recalcitrant chemical composition of the grass and location of the incubation experiment. Fiber analyses indicated that lignin and cellulose comprised 68% of the total ash free dry weight of the plant. A prediction of the potential annual input of mudflat primary production to the Sardis Reservoir food web can be made based on two initial estimates. Significant biomass of plants occurring in the mudflat elevation range of 76 to 79 m. Based on a maximum annual production of 422 g C/sq m, 100% of this production is available to the food web through decomposition or by direct use by higher trophic levels after inundation of mudflats. The relative importance of primary production on these mudflats and subsequent production of POC could increase as reservoirs age and other sources of nutrients decrease. (Brunone-PTT)
W91-12785

PHYTOPLANKTON INTERACTIONS BETWEEN TWO CONNECTED HIGHLY EUTROPHIC RESERVOIRS.
Gelsenwasser A.G., Gelsenkirchen (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W91-12787

WATER QUALITY ASPECTS OF TWO SMALL SHALLOW MAN-MADE IMPOUNDMENTS WITH DIFFERENT WATER RESIDENCE TIMES.
Internationale Kommission zum Schutze des Rheins gege Verunreinigung, Koblenz (Germany, F.R.).
A. Schulte-Wulwer-Leidig.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1319-1323, March 1991. 3 fig, 3 tab, 4 ref.

Descriptors: *Algal growth, *Dam effects, *Eutrophication, *Flood-control storage, *Limnology, *Reservoirs, *Retention time, *Storage reservoirs, *Water pollution effects, *Water quality, Chlorophyll, Dissolved organic carbon, Nutrient concentrations, Stratification, Vertical profile, Wastewater pollution, Water temperature.

The change in water quality due to the damming of flowing water, particularly the change in nutrient and mineral content, was investigated in two small flood-control impoundments in the Rhenish Slate Mountains in Germany over a 3 year period. The Ittertal impoundment has a residence time of 14.5-99.2 days; the Eicherscheid's residence time is 0.3-8.1 days. About 70% of the total phosphorus concentration at the inflow of the Ittertal impoundment belongs to the soluble fraction immediately biologically available, which is due to the influence of sewage. The impoundment with a relatively high water residence time of several weeks has a correspondingly high bioproduction. At the same time, the dissolved organic carbon rises by 67.7% (secondary pollution). The extreme decrease in nutrient concentrations occurring in the Ittertal impoundment is largely due to uptake by the biomass followed by sedimentation. The relationship between theoretical residence time and chlorophyll a concentration at the Eicherscheid impoundment shows a clear increase in the chlorophyll a concentration when the residence time exceeds one day. A comparison of this correlation with one made for the Ittertal reservoir shows that a longer theoretical retention time neither plays an initiating nor an increasing role with respect to the algal growth, meaning no clear relation exists. During the summers of 1985 and 1986, distinct temperature gradients could be measured in the vertical profile of the Eicherscheid impoundment. The results show that the stratification due to the difference in temperature in shallow water bodies with a comparatively high through-flow remain as long as conditions of discharge do not substantially change. The stability of the temperature gradient substantially increases with diminishing discharge and sufficiently high radiation intensity. (Brunone-PTT)
W91-12788

SAPROPHYTIC AND FAECAL COLIFORM BACTERIA IN THE SEDIMENT OF THE IMPOUNDMENT ALTENWORTH.
For primary bibliographic entry see Field 5A.
W91-12789

PHYTOPLANKTON AND THEIR CONNECTION WITH CYCLIC SUNSPOTS IN THE SEDLICE DAM (DAS PHYTOPLANKTON UND SEINE BEZIEHUNG ZUM SONNENFLECKENZYKLUS IN DER TALSPERRE SEDLICE).
Tschechoslowakische Akademie fur Landwirtschaft, Janackovo nab. 31, CS-15000 Praque, Czechoslovakia.
M. Stepanek.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1330-1331, March 1991. 1 fig, 8 ref.

Descriptors: *Czechoslovakia, *Light intensity, *Limnology, *Meteorology, *Phytoplankton, *Population dynamics, *Primary productivity, *Reservoirs, *Sedlice Dam, *Sunspot activity, *Ultraviolet radiation, Dams, Limiting nutrients, Meteorological data, Nanoplankton, Nitrogen, Phosphorus.

The International Program of the Geosphere-Biosphere investigated the relationship between periodic sunspot activity and the phytoplankton population dynamics in the Sedlice Dam lake. Increased sunlight provides increased ultraviolet intensity, from the increased solar activity. The relative number of sunspots and the primary productivity of the nanoplankton in the Sedlice dam reservoir are related (with $n = 34$ and $r = 0.892$). The water in the reservoir is eutrophic, with nutrients from runoff of fields and gardens. The nutrients nitrogen and phosphorus are also limiting to the growth of this nanoplankton. (Brunone-PTT)
W91-12790

PERIODIC INTERANNUAL OSCILLATIONS IN BACTERIAL NUMBERS AND ACTIVITY RELATED TO METEOROLOGICAL CYCLES.
Ceskoslovenska Akademie Ved, Ceske Budejovice. Hydrobiologicka Lab.
V. Straskrabova.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1332-1335, March 1991. 2 fig, 2 tab, 13 ref.

Descriptors: *Bacteria, *Czechoslovakia, *Limnology, *Meteorology, *Population density, *Population dynamics, *Sunspot activity, Annual distribution, Bacterial analysis, Biomass, Klicava Reservoir, Meteorological data, Periodicity, Primary productivity, Slapy Reservoir, Stagnant water, Temperature effects, Water sampling, Zooplankton.

An analysis of a ten year (1960-1970) series of data for two reservoirs (Slapy and Klicava) in Czechoslovakia was made to analyze long-term oscillations in bacterial numbers and activity. The reservoirs were sampled every three weeks in the deep stagnant area near the dam. Bacterial numbers were determined in the surface layer as microscopic erythrosine-stained counts on membrane filters. During the sampling period, two distinct periods with very high bacterial numbers were noted (1961 to 1962 and 1968 to 1970) with a period with lower numbers between them. Though bacterial volumes showed slightly and insignificantly higher values at lower bacterial numbers, the calculated biomasses were still one order higher during the high numbers period than during the other one. Meteorological phenomena fluctuating periodically on both the reservoirs were connected with interannual cycles of sun activity and thermal cycles. The sharp increases in bacterial numbers occurred at the ends or after the peaks of sun activity and temperature. The biomass and production of phytoplankton and the biomass of zooplankton also showed interannual fluctuations, but the differences were much lower. At high bacterial numbers, the low zooplankton to phytoplankton ratio indicates a lower use of primary production by herbivorous zooplankton and a higher direct use of primary production by bacteria. During the low bacteria period, most of primary production is used by herbivorous zooplankton and a smaller part is available for bacteria. (Brunone-PTT)
W91-12791

CLEAR-WATER PHASE IN THE RIMOV RESERVOIR (SOUTH BOHEMIA): CONTROLLING FACTORS.
Ceskoslovenska Akademie Ved, Ceske Budejovice. Hydrobiologicka Lab.
V. Vyhnalek, J. Komarkova, J. Seda, Z. Brandl, and K. Simek.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1336-1339, March 1991. 4 fig, 16 ref.

Descriptors: *Czechoslovakia, *Food chains, *Limnology, *Mathematical models, *Model studies, *Phytoplankton, *Rimov Reservoir, *Zooplankton, Algal growth, Biomass, Decomposition, Limiting nutrients, Population dynamics, Seasonal variation.

The spring development of phytoplankton in the Rimov Reservoir during the years 1984 to 1988 was compared with the PEG model, in which zooplankton causes the decrease of phytoplankton biomass and maintains the low density during the clear water phase. The maximum phytoplankton biomass coincided with the appearance of the thermocline, but phytoplankton grew slowly over this period in 1986, probably due to phosphorus limitation. The spring maximum rapidly declined, forming the clear water phase. Pathways for loss of phytoplankton are physiological death and subsequent decomposition by bacteria, grazing by zooplankton, and sedimentation. Bacterial numbers were maximal, and the fractions of bacteria attached to particles highest, during and after the phytoplankton peak in 1987 and 1988. Zooplankton grazing seemed to be able to reduce the phytoplankton biomass only after growth rates fell and transport of cells ceased. These results indicate that physical and chemical variables seemed to be the most important factors controlling the spring rise of phytoplankton in the Rimov Reservoir. Phosphorus limitation appeared to be responsible for the cessation of the bloom, and a combination of bacterial decay of cells and consumption by zooplankton, resulted in the decrease of phytoplankton biomass. The PEG model cannot be applied without modification to explain spring phytoplankton dynamics in the Rimov Reservoir. In addition to zooplankton grazing, three other factors are important: inflow of river water, phosphorus limitation, and bacterial degradation of dead algal cells. (Brunone-PTT)
W91-12792

PHYTOPLANKTON OF A LAKE AND A STORAGE SITUATED ON THE SAME RIVER RESERVOIR (LE PHYTOPLANCTON D'UN LAC ET D'UN RESERVOIR D'ACCUMULATION SITUES DANS LE COURS D'UNE MEME RIVIERE).
Institute of Physical Planning and Municipal Economy, Poznan (Poland).
For primary bibliographic entry see Field 5C.
W91-12793

LIMNOLOGY OF LOWLAND SHALLOW IMPOUNDMENT NEAR WARSAW, POLAND.
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
For primary bibliographic entry see Field 5B.
W91-12794

ZOOPLANKTON UNDER STRESS CAUSED BY SEDIMENT RESUSPENSION.

Nicholas Copernicus Univ. of Torun (Poland). Dept. of Hydrobiology.
L. A. Bledczki.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1349-1350, March 1991. 3 fig, 1 tab, 6 ref. PAS Grant CPBP 04.10.08.

Descriptors: *Bottom sediments, *Limnology, *Oxygen deficit, *Sedimentation, *Suspended sediments, *Wloclawek Reservoir, *Zooplankton, Animal physiology, Dissolved oxygen, Mortality, Oxygen requirements, Spatial distribution, Water depth, Waterfleas, Wind.

In the shallow areas of the Wloclawek Dam Reservoir, large oxygen deficits were noted, probably caused by hydrological (current) and meteorological (wind) changes as well as man-induced (dredging) sediment resuspension. During laboratory investigations, using bottom sediments colleted from shallow parts of the reservoirs, increased sediment oxygen demand was noted during sediment resuspension. All populations of Daphnia magna died on the fourth day in the water in which previous sediment resuspension took place. Slight decreases in the lifespan of Daphnia may be influenced by toxicants released from bottom deposits. The results show that resuspension of bottom deposits may cause oxygen deficits, which can cause increased mortality of Daphnia. This result may be a major factor influencing horizontal, vertical, and temporal heterogeneity of zooplankton. (Brunone-PTT)
W91-12795

BIOLOGICAL INVESTIGATIONS OF THE UPPER VOLTA-MOZHAYSK DRINKING WATER RESERVOIR.

Moscow State Univ. (USSR). Dept. of Hydrobiology.
N. J. Sokolova, and M. Y. Sakharova.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1351-1352, March 1991. 2 ref.

Descriptors: *Benthic fauna, *Eutrophication, *Limnology, *Moscow River, *Mozhaysk Reservoir, *Population density, *Reservoirs, *Volga River, *Water pollution effects, Agricultural runoff, Biomass, Bream, Cyanophyta, Fish populations, Nonpoint pollution sources, Phytoplankton, Pyrrophyta, Recreation, Tubificids, Waterfleas.

The Mozhaysk Reservoir was built in 1960 on the upper reaches of the Moscow River to regulate runoff and provide the Moscow water supply. In the 1970's, blue-greens were replaced by pyrrophytes. In the early 1980's the average biomass of phytoplankton increased two-fold and the number decreased two-fold. The structure of the benthic communities has changed over time, with three communities found at present: the Chironomus and Cladotanytarsus mancus community found near the shore, the same two species (Chironomus and Cladotanytarsus) plus Stictochironomus rosenscholdi found on the sandy beaches of the abraded inshore, and the Chironomus and Limnodrilus community which occupies the zone of permanent submersion. The first two communities are characterized by seasonal fluctuations. Along the longitudinal axis of the water reservoir, the highest biomass is recorded on the boundary between the upper and middle regions where the conditions are the most favorable. The ratio of biomass of the Chironomidae to Tubificidae increased from 5:6 in 1973 to 1.4:2.3 in subsequent years. This ratio change indicates more intensive silting and increasing eutrophication of the reservoir. The nutrient load is continuously increasing due to intensification of agriculture and increased recreational use of the water and the shore. In recent years, the ichthyofauna has shown an increase in bream. Numbers of predatory fish have declined. (Brunone-PTT)
W91-12796

MACROINVERTEBRATE COMMUNITY STRUCTURE AND IMPACT ASSESSMENT OF DAMS AND IMPOUNDING RESERVOIRS IN THE CAVADO RIVER BASIN (NORTHERN PORTUGAL).

Porto Univ. (Portugal). Inst. de Zoology.
A. P. Fontoura, and N. De Pauw.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1353-1359, March 1991. 4 fig, 1 tab, 15 ref.

Descriptors: *Cavado River Basin, *Dam effects, *Invertebrates, *Limnology, *Portugal, *Reservoirs, *Species diversity, *Water level fluctuations, Biotic index, Chemical properties, Environmental effects, Flow velocity, Lisec index, Water quality.

The Cavado River basin is located in the mountainous northern part of Portugal, in which eight reservoirs have been established with a total storage capacity of 1.1 billion cubic m. The invertebrate communities were sampled in twenty-four stations located in the upper part of the basin. The impact of dams in the Cavado River basin is clearly demonstrated by the analysis of the macroinvertebrate community structure. The number of individuals and taxa, and the diversity decreases in the sampling stations located not only inside but also immediately upstream of the reservoir. Immediately upstream of the reservoirs exist a stretch of river where the macroinvertebrate community is disturbed by the periodic changes of the environmental conditions. The disturbance of macroinvertebrate communities is induced by fluctuations in current speed which are related to other habitat characteristics such as substrate homogeneity. The physical impact of dams could be clearly demonstrated using a biotic index. In the Cavado River basin, the chemical water quality index, expressed by the Lisec index, always appeared to be good or even excellent. The biological water quality, expressed as the Belgian Biotic Index, sharply decreased in 2 of the 8 reservoirs. Thus, the physical impact of dams could be clearly demonstrated by a biotic index. (Brunone-PTT)
W91-12797

MACROINVERTEBRATES OF MONTE NOVO RESERVOIR (EVORA, PORTUGAL): YEARLY EVOLUTION OF THE CENOTIC STRUCTURE.

Evora Univ. (Portugal). Dept. de Biologia.
P. Pinto.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1360-1362, March 1991. 3 fig, 2 tab, 10 ref.

Descriptors: *Invertebrates, *Limnology, *Monte Novo Reservoir, *Portugal, *Reservoirs, *Species composition, *Species diversity, Annual distribution, Biological sampling, Population density, Spatial distribution, Water sampling, Water temperature.

Macroinvertebrate community structure was evaluated in Monte Novo Reservoir, located in southeast Portugal. From April 1986 to March 1987, monthly samples were taken with Birge Ekman grab samplers at two sampling stations: one at the edge of the reservoir and the other in a deep zone (17 m). Total species richness and the Shannon-Weaver diversity index were calculated. For all the computed indexes, the edge stations presents a continuum over the whole year, which can be related to the ecological status of the reservoir. The clumping indexes show low fluctuations from April to July. From October to December, a decreasing clumping index trend was detected, suggesting better spatial resource availability, and the beginning of new colonization. This new colonization corresponds to the autumn recruitment and lasts until the rainfalls in late January. In March the cycle begins again. The deep water station had a lower total richness and no clear continuum. At both stations, the diversity and number of individuals is highest in spring, early summer and winter, with a maximum in October possibly related to the thermocline disappearance. (Brunone-PTT)
W91-12798

MAJOR IONIC COMPOSITION IN THE SPANISH RESERVOIRS.

Barcelona Univ. (Spain). Dept. de Ecologia.
J. Armengol, J. L. Riera, and J. A. Morgui.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1363-1366, March 1991. 2 fig, 1 tab, 15 ref.

Descriptors: *Acid rain, *Lake classification, *Limnology, *Reservoirs, *Spain, *Surface water, *Water chemistry, *Weathering, Alkalinity, Calcium, Carbonates, Chlorides, Climatic effects, Environmental effects, Equilibration, Eutrophication, Ion concentrations, Rainfall, Sedimentation, Silicates, Spatial distribution, Sulfates.

In Spain, the chemical weathering of rocks and soils is the main factor determining surface water composition. From 1972 to 1975 an areal survey of 100 reservoirs was done to establish a typology based on their ecological properties. This classification was based on alkalinity and calcium concentrations, but reflects geological, climatological, and geographical factors. Reservoirs located in the westernmost region of Spain have catchments on siliceous rocks and waters have low total dissolved salts. In contrast, reservoirs in the eastern region have catchments dominated by sedimentary rocks with waters having high total dissolved salts. Temporal trends in water composition differ between western and eastern reservoirs. When relative water composition and total dissolved salts (TDS) concentration are considered, four groups of reservoirs can be established. First, the western reservoirs have water with low TDS, with an equilibrated relative composition of CO3(2-) > Cl(-) = SO4(2-), are characterized by high silicate concentrations and lower buffering capacity. In these reservoirs, rainfall is an important factor determining the major ionic concentrations. Second, in eastern reservoirs with bicarbonate waters (CO3(2-) > SO4(2-) > Cl(-)) the TDS have intermediate values between 150 and 450 mg/L. These reservoirs are located mainly in north and northeast Spain, and have the highest buffering capacity. Third, reservoirs with sulfate waters (SO4(2-) > CO3(2-) > Cl(-)) are distributed over the endorrheic areas of central, south and east Spain. The alkalinity ranges from 1.2-3.9 meq/L, TSD from 400-1,000 mg/L, and they are more sensitive to eutrophication. Last, reservoirs with high TDS, dominance of chloride and occasionally with high concentrations of sulfate. Seven reservoirs, located mainly in south Spain, belong to this group, which is characterized by inputs of saline water coming from sedimentary areas with accumulations of evaporitic minerals. (Brunone-PTT)
W91-12799

CHANGES IN THE TROPHIC STATE OF THE SPANISH RESERVOIRS DURING THE LAST SIXTEEN YEARS.

Barcelona Univ. (Spain). Dept. de Ecologia.
J. L. Riera, E. Marti, and J. A. Morgui.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1367-1370, March 1991. 2 tab, 5 ref.

Descriptors: *Eutrophication, *Lake classification, *Limnology, *Nutrient concentrations, *Reservoirs, *Spain, *Surface water, *Water chemistry, Denitrification, Ion concentrations, Microorganisms, Nitrates, Nitrites, Nitrogen compounds, Phosphorus, Seasonal variation, Silicates, Statistical analysis, Trophic level.

During 1986 to 1987, a survey was taken of one hundred reservoirs, located throughout Spain, to analyze nutrient concentrations and changes in soluble reactive phosphorus (SRP) and oxidated forms of nitrogen oxides. Analysis of variance (ANOVA) was used to analyze the data gathered. Reservoirs belonging to the calcareous region show, on average, greater values for nitrite, nitrate and the (NO2 + NO3):SRP ratio than the reservoirs which belong to the siliceous region. ANOVA results often reflected differences in trophic stage. Seasonal differences are only significant for NO3 and the (NO2 + NO3):SRP ratio. A significant increase in the oxides of dissolved organic nitrogen is apparent. The increase represents a greater pool of oxides but an intensification of

the microbial anaerobic metabolism may be expected, due to an intensification of denitrification and nitrate reduction. (Brunone-PTT)
W91-12800

DISTRIBUTIONAL PATTERNS OF PHYTOPLANKTON IN SPANISH RESERVOIRS: FIRST RESULTS AND COMPARISON AFTER FIFTEEN YEARS.
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 5C.
W91-12801

EFFECT OF EXTERNAL PHOSPHORUS, NITROGEN AND CALCIUM ON GROWTH OF LEMNA TRISULCA.
Manitoba Univ., Winnipeg. Dept. of Botany.
D. Huebert, and J. M. Shay.
Aquatic Botany AQBODS, Vol. 40, No. 2, p 175-183, May 1991. 5 fig, 2 tab, 19 ref.

Descriptors: *Aquatic plants, *Calcium, *Limiting nutrients, *Limnology, *Nitrogen, *Phosphorus, *Plant growth, Ivy duckweed, Macrophytes, Nutrients.

Lemna trisulca L. was grown under a wide range of phosphorus, nitrogen or calcium levels in an otherwise complete nutrient medium. The multiplication rate averaged 148 +/-6 as the external phosphorus was lowered from 240 to 7.5 microM and the internal concentration fell from 1.81 to 0.46%. A critical internal concentration of phosphorus was estimated as between 0.46 and 0.65%. The multiplication rate averaged 129 +/-3 as the external nitrogen was lowered from 500 to 31 microM. Below this value the growth rate fell steadily to a low of 61 when nitrogen was excluded from the medium. The multiplication rate averaged 143 +/-6 between 27.5 and 220 microM external calcium. Above 220 microM the growth rate was reduced but below 27.5 microM the plants either became deformed or did not survive. (Author's abstract)
W91-12803

DECOMPOSITION AND COLONIZATION BY INVERTEBRATES OF TYPHA LATIFOLIA L. LITTER IN CHACO CATTAIL SWAMP (ARGENTINA).
Centro de Ecologia Aplicada del Litoral, Corrientes (Argentina).
I. Y. Bruquetas de Zozaya, and J. J. Neiff.
Aquatic Botany AQBODS, Vol. 40, No. 2, p 185-193, May 1991. 2 fig, 2 tab, 29 ref.

Descriptors: *Cattails, *Colonization, *Decomposition, *Invertebrates, *Limnology, *Litter, *Swamps, *Wetlands, Biodegradation, Biological studies, Decomposing organic matter, Dissolved oxygen, Ecosystems, Leaves.

Litter containers with dead leaves of Typha were submersed above and under a floating island, and were also suspended in air. Three litter containers were retrieved from each site after 7, 15, 30, 45, 75 and 150 days. Dry weight losses and decay coefficients were calculated. After 150 days of immersion, litter decomposition was 50% and 39% of the initial weight for samples incubated above and under the floating island, respectively. Samples suspended in air decomposed more slowly; at the end of the study only a 16% weight loss had occurred. Maximum densities of invertebrates were found in samples above the floating island. Collectors were the most abundant, especially Dero (Dero) spp. (Oligochaeta) during incubation and Scirtes spp. (Coleoptera larvae) were abundant at the end of the study. Under the floating island, colonization by invertebrates was scarce. Macroinvertebrate densities increased slightly in E. crassipes leaf litter incubated under T. latifolia but were lower than densities found under aerobic conditions. In helophyte communities, low dissolved oxygen content and acidic pH may have contributed to the low decomposition of T. latifolia and limited the number of invertebrate colonizers. (Lantz-PTT)
W91-12804

EFFECTS OF GEOTHERMAL GROUNDWATER ON NUTRIENT DYNAMICS OF A LOWLAND COSTA RICAN STREAM.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
For primary bibliographic entry see Field 2F.
W91-12805

ROLE OF NUTRIENT CYCLING AND HERBIVORY IN REGULATING PERIPHYTON COMMUNITIES IN LABORATORY STREAMS.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5G.
W91-12806

FISH COMMUNITY STRUCTURE IN DRY-SEASON STREAM POOLS.
East Texas State Univ., Commerce. Dept. of Biological Sciences.
T. A. Capone, and J. A. Kushlan.
Ecology ECOLAR, Vol. 72, No. 3, p 983-992, June 1991. 5 fig, 3 tab, 58 ref.

Descriptors: *Ecosystems, *Fish populations, *Streams, *Water deficit, Bullhead, Channel morphology, Environmental effects, Gambusia, Hydrogen ion concentration, Limnology, Seasonal variation, Statistical analysis, Sunfish, Texas, Water depth.

Fish assemblage patterns were examined in 40 dry-season pools in a hydrologically variable river drainage in northeast Texas, to test the hypothesis that fish assemblage structure is correlated with environmental gradients of habitat characteristics. The study focused on two points: (1) whether discrete, identifiable fish assemblage patterns exist, and (2) if so, how they relate to environmental conditions. The null hypothesis that fishes were randomly distributed among pools was rejected, indicating that assemblage patterns existed. Cluster analyses of the relative abundance of fish species detected three fish assemblages dominated by: mosquitofish; black bullhead; and sunfish-shiner-mosquitofish. Factor analysis reduced environmental variables to six factors representing pool depth, pool persistence, channel size, canopy cover, pool substrate, and pH, by which assemblages could be discriminated. These results demonstrated a relation between fish assemblage structure and environmental conditions in the pools. The discriminating variables varied along a gradient, and fish assemblages varied similarly. The study supported model predictions for gradient trends in species richness, species composition, fish size, and fish density, but not for species density. (Author's abstract)
W91-12807

LIMNOLOGICAL STUDY OF LAKE YPACARAI (ESTUDIO LIMNOLOGICO DEL LAGO YPACARAI).
Universidad Nacional de Asuncion (Paraguay). Inst. de Ciencias Basicas.
B. Ritterbusch.
Revista de la Asociacion de Ciencias Naturales del Litoral RCNLDW, Vol. 19, No. 1, p 11-26, 1988. 5 fig, 12 tab, 20 ref. English summary.

Descriptors: *Holomictic lakes, *Lake Ypacarai, *Lake restoration, *Limnology, *Paraguay, Erosion, Industrial wastes, Municipal wastes, Water pollution effects.

Lake Ypacarai is a shallow reservoir, dammed by a natural barrier. It is the largest lake in Paraguay and the most important for human activities; it serves primarily as a recreational resource for the population in the area of Paraguay's capital, Asuncion. Contamination of the water by human and industrial wastes is increasing. The various uses of the lake's waters are partially contradictory; thus a general plan for rational management of the lake and its basin is required. An interdisciplinary project was developed to study the lake and to propose ideas to help with the future solution of the problems detected. The lake is an open ecosystem which is characterized by its high turbidity, constant and complete water mixing (polioholomixis), short retention time, and very small plant and animal populations. There are ongoing cycles of allochthonous contributions, sedimentation, and exportation of organic and inorganic matter. Although the chemical conditions of the environment are favorable for a rich primary productivity, physical conditions permanently limit the development of biological populations. Primary and secondary productivity are minimal, due to turbidity and current velocities. Ypacarai is highly impacted by organic and inorganic material from its surroundings; it is unable to maintain an internal limnological equilibrium, but serves primarily as recipient of sediments and human and industrial wastewaters. It will be possible to restore the self-regulation of the system's water quality only through sanitary treatment of its influents in combination with erosion control by means of appropriate land management. (Shidler-PTT)
W91-12839

ANNUAL CYCLE AND SPATIAL HETEROGENEITY OF AUTOTROPHIC AND HETEROTROPHIC PROCESSES, AND PHYSICO-CHEMICAL FEATURES OF RIO TERCERO RESERVOIR, CORDOBA, ARGENTINA (CICLO ANUAL Y HETEROGENEIDAD ESPACIAL DE PROCESOS AUTOTROFICOS Y HETEROTROFICOS, Y CARACTERES FISICO-QUIMICOS DEL EMBALSE RIO TERCERO, CORDOBA, ARGENTINA).
Universidad Nacional de La Plata (Argentina). Inst. de Limnologia.
A. A. Mariazzi, M. C. Romero, and V. H. Conzonno.
Revista de la Asociacion de Ciencias Naturales del Litoral RCNLDW, Vol. 19, No. 2, p 167-181, 1988. 9 fig, 1 tab, 29 ref. English summary.

Descriptors: *Argentina, *Limnology, *Primary productivity, *Reservoirs, *Water circulation, Algal populations, Ammonia, Cycling nutrients, Heterotrophic bacteria, Nitrates, Oxygen, Phosphates, Seasonal variation, Temperature.

Two marked periods of summer stratification and winter circulation of oxygen concentration, temperature, ammonia, nitrates, orthophosphates and bacterial heterotrophic activity were recorded at the Rio Tercero Reservoir, Argentina. Primary production and biomass of phytoplankton showed a bimodal distribution, with two peaks, one in spring-summer, the other in winter. The high proportion of phaeopigments in relation to total photosynthetic pigments that was observed in January was attributed to photochemical and thermal decomposition of chlorophyll. Oxygen depletion below 15 m depth (0.50 mg O2/L) was observed during summer as well as oversaturation in the euphotic zone during winter. Nutrients also showed a conspicuous seasonal variation. Nitrates and orthophosphates exhibited the highest values (44 mg NO3(-)-N/.01 L and 36 microgram PO4(3-)-P/L) at depths and months in which algal biomass and primary production decreased, whereas very low values were found during spring-summer. Heterotrophic bacterial activity was highly correlated to algal biomass and primary production as well. Both rates increased in February-March. A significant correlation was not observed between heterotrophic potential and the number of bacteria. (Author's abstract)
W91-12842

WATER CIRCULATION OF THE DANUBE DELTA--ECOLOGICAL AND ECONOMIC SIGNIFICANCE (DER WASSERUMLAUF IM DONAUDELTA--OKOLOGISCHE UND WIRTHSCHAFTLICHE BEDEUTUNG).
Institutul de Geografie, Bucharest (Romania).
For primary bibliographic entry see Field 2E.
W91-12844

DYNAMICS OF THE WLOCLAWEK RESERVOIR BANKS.
Nicholas Copernicus Univ. of Torun (Poland). Inst. of Geography.
For primary bibliographic entry see Field 2J.
W91-12846

APPLICATIONS OF THREE COMPLETELY MIXED COMPARTMENT MODELS TO THE LONG-TERM FATE OF DIELDRIN IN A RESERVOIR.
Polytechnic Univ., Brooklyn, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W91-12847

LONG-TERM PHENOMENOLOGICAL MODEL OF PHOSPHORUS AND OXYGEN FOR STRATIFIED LAKES.
Colorado Univ. at Boulder. Center for Advanced Decision Support for Water and Environmental Systems.
S. C. Chapra, and R. P. Canale.
Water Research WATRAG, Vol. 25, No. 6, p 707-715, June 1991. 8 fig, 2 tab, 28 ref.

Descriptors: *Cycling nutrients, *Limnology, *Model studies, *Phosphorus, *Stratified lakes, *Water pollution effects, *Water quality trends, Computer models, Lake sediments, Oxygen, Path of pollutants, Pollution load, Shagawa Lake.

A budget model was developed to predict the long-term response of a lake to changes in its phosphorus loading. This model computed total phosphorus and hypolimnetic oxygen concentrations, taking sediment-water interactions into account. The lake was treated as two segments: the water and a surface sediment layer. A total phosphorus budget for the water accounted for inputs due to external loading and recycle from the sediments. It reflected losses due to flushing and settling. The sediment layer gained total phosphorus by settling and lost total phosphorus by recycle and burial. The recycle from the sediments to the water was dependent on the levels of sediment total phosphorus and hypolimnetic oxygen. Hypolimnetic oxygen concentration was estimated with a semi-empirical model. The model was applied to Shagawa Lake, MN. Analysis was performed to demonstrate how its predictions replicated in-lake changes not possible with simpler phosphorus budget models. The model did a credible job of simulating the recovery of Shagawa Lake. The model had the advantage of having relatively few parameters. This facilitated direct estimation of all model parameters using field and laboratory measurement techniques. According to the model, systems such as Shagawa Lake would take many years to become totally saturated with phosphorus. Once thoroughly polluted, however, they would take similarly long to be cleansed. (Mertz-PTT)
W91-12856

SIMPLE, DYNAMIC MODEL FOR THE SIMULATION OF THE RELEASE OF PHOSPHORUS FROM SEDIMENTS IN SHALLOW, EUTROPHIC SYSTEMS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 5B.
W91-12859

BENTHIC MACROINVERTEBRATE COMMUNITY IN A COASTAL SAND DUNE LAKE RELATIVE TO HABITAT AND CHANGING LAKE LEVELS.
Oregon State Univ., Corvallis. Coll. of Forestry.
A. G. Wones, and G. L. Larson.
Hydrobiologia HYDRB8, Vol. 213, No. 3, p 167-181, May 10, 1991. 7 fig, 4 tab, 39 ref, append.

Descriptors: *Benthic environment, *Carter Lake, *Coastal lakes, *Ecosystems, *Limnology, *Macroinvertebrates, *Water level fluctuations, Biomass, Crustaceans, Littoral environment, Oregon, Sand dunes, Water level.

The benthic macroinvertebrate community (BMI) in a freshwater coastal dune lake without a surface outlet was investigated in May and October, 1986. Fifty-three invertebrate taxa were identified from Carter Lake, Oregon, including three euryhaline crustacean species (Corophium spinicorne, Gnorimosphaeroma oregonensis lutea, and Acanthomysis awatchensis). Corophium spinicorne dominated the BMI communities of the littoral zones and sphaeriid clams dominated the deep water community. The lake level dropped about 2.5 m between April and October. Based upon this decline, the lake bottom was divided into four major habitats: a sandy temporarily submerged littoral zone (A); a sandy submerged littoral zone (B); a mid-depth zone of mixed mud and sand and the macrophyte, Nitella (C); and a deep zone (D) with soft mud. The average density of BMI was highest in the littoral zones (A and B) in May and in zone B in October (zone A was dry). The lowest density occurred in zone D. In May, BMI biomass was highest in the mid-depth zone in October. The mid-depth zone had the most diverse community. The two most abundant species in the temporarily submerged area, C. spinicorne and Juga plicifera, were found in greater numbers deeper in the lake after the water level dropped, suggesting migration by these species in response to changing water levels. (Author's abstract)
W91-12886

EFFECT OF RESUSPENSION ON ALGAL PRODUCTION IN A SHALLOW LAKE.
Uppsala Univ. (Sweden). Dept. of Hydrology.
T. Hellstrom.
Hydrobiologia HYDRB8, Vol. 213, No. 3, p 183-190, May 10, 1991. 4 fig, 4 tab, 19 ref.

Descriptors: *Algal growth, *Limnology, *Shallow water, *Suspended load, *Suspended sediments, Bottom sediments, Ecosystems, Erosion, Light intensity, Sweden, Tamnaren Lake, Turbidity, Wind speed.

Waves cause erosion and the resuspension of bottom sediments. In shallow lakes, resuspension can take place over most of the lake area and the resuspended matter can stay in suspension for such a long time that the mean light intensity in the lake is reduced, causing reduced algal growth. The increase of suspended matter and light attenuation in the water of lake Tamnaren, Sweden, was found to be proportional to wind velocity to the third power. After each storm, an increased attenuation of light occurred which lasted for a week. The algal production was estimated to be reduced to only 15% of what it would have been without increased turbidity due to resuspension. (Author's abstract)
W91-12887

MICROBIOLOGY AND CHEMISTRY OF ACID LAKES IN FLORIDA: I. EFFECTS OF DROUGHT AND POST-DROUGHT CONDITIONS.
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W91-12888

MICROBIOLOGY AND CHEMISTRY OF ACID LAKES IN FLORIDA: II. SEASONAL RELATIONSHIPS.
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W91-12889

MACROALGAE OF A STREAM IN SOUTHEASTERN BRAZIL: COMPOSITION, SEASONAL VARIATION AND RELATION TO PHYSICAL AND CHEMICAL VARIABLES.
Universidade Estadual Paulista, Sao Jose do Rio Preto (Brazil). Dept. of Botanica.
O. Necchi Junior, M. Ribeiro Dip, and R. Maira Goes.
Hydrobiologia HYDRB8, Vol. 213, No. 3, p 241-250, May 10, 1991. 9 fig, 2 tab, 27 ref. CNPq Grant No. 800247/88-44.

Descriptors: *Brazil, *Chemical properties, *Macroalgae, *Physical properties, *Seasonal variation, *Species composition, *Stream biota, Dissolved oxygen, Ecosystems, Hydrogen ion concentration, Population dynamics, Precipitation, Turbidity.

Macroalgal seasonality was studied monthly in a second-order stream in the north-west of Sao Paulo State, S. E. Brazil. Seasonal variation was based on frequency and percentage cover. Seven species were found during the study period, three of which (Chantransia stage of Sirodotia delicatula, Homoeothrix juliana and Klebsormidium subtile) were encountered throughout the year and showed well-defined seasonal patterns as well as the highest value of frequency and percentage cover. Chantransia and H. juliana dominated in summer and fall, while for K. subtile winter was the most favorable period. The remaining species (Oscillatoria agardhjii, Microcoleus subtorulosus, Oedogonium sp. and Chaetophora elegans) had no clear seasonal pattern, in addition to their low values of frequency and percentage cover. Individually, K. subtile correlated with a higher number of physical and chemical variables (oxygen, pH, precipitation, temperature, day length, conductance and turbidity) than Chantransia and H. juliana (discharge and depth). Principal component analyses revealed that no single variable was responsible for the macroalgal seasonal dynamics. The variables most closely related to seasonal variation of the macroalgal community were day length, precipitation, discharge, turbidity and dissolved oxygen. Precipitation and flow were suggested as key factors in determining the seasonality of macroalgae. (Author's abstract)
W91-12890

RESULTS OF A LABORATORY EXPERIMENT RELATING SPECTRAL REFLECTANCE TO TOTAL SUSPENDED SOLIDS.
Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
For primary bibliographic entry see Field 7B.
W91-12898

ELECTROCHEMICAL ASSESSMENT OF ESCHERICHIA COLI SURVIVAL IN NATURAL WATER.
Rouen Univ., Mont-Saint-Aignan (France). Lab. de Chimie Macromoleculaire.
For primary bibliographic entry see Field 5A.
W91-12913

VEGETATIVE SPREAD OF EURASIAN WATERMILFOIL IN LAKE GEORGE, NEW YORK.
Rensselaer Polytechnic Inst., Troy, NY. Rensselaer Color Measurement Lab.
J. D. Madsen, L. W. Eichler, and C. W. Boylen.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 109-114, 11 ref.

Descriptors: *Aquatic weeds, *Lake George, *Limnology, *Plant growth, *Reproduction, *Water milfoil, Colonization, Distribution patterns, Macrophytes, New York, Population dynamics.

Vegetative spread of Eurasian watermilfoil was studied in two field experiments and one laboratory experiment on populations from Lake George, New York. Local spread by stolons exhibited a strong seasonal component related to growth, with an increase in colonization in mid-summer followed by a decline late in the season, correlated to plant mortality. Plant colonies are therefore dynamic seasonally, not merely colonies that increase linearly. Fragment deposition on littoral substrates showed a strong seasonal trend, with highest fragmentation in late September. Laboratory experiments in which Euasian watermilfoil fragments were grown in lake water indicated that fragments not only survived, but increased in length and biomass while suspended in the water column for long periods of time. Thus the two effective means for spread of the water milfoil in Lake George were local spread by stolons and medium to long distance spread by fragmentation. (See also W91-12922) (Author's abstract)
W91-12931

NUISANCE AQUATIC MACROPHYTE GROWTH.
Corps of Engineers, Walla Walla, WA. Walla Walla District.
E. Hesser, and E. O. Gangstad.
IN: Natural Resource Management of Water and

Land. Van Nostrand Reinhold, New York. 1990. p 115-121, 2 fig, 2 tab, 7 ref.

Descriptors: *Aquatic weeds, *Irrigation effects, *Plant growth, *Urbanization, Columbia River, Distribution patterns, Hornworts, Land use, Pondweeds, Snake River, Stoneworts, Water crowfoot, Water milfoil, Waterlilies, Waterweeds.

Aquatic macrophytes of the Columbia and Snake River watersheds were observed at 723 sites in Washington, Oregon, and Idaho and classified according to adjacent land use, water body type, altitude, water temperature and nuisance growth. The prevalence of eight weed species, Elodea, Potamogeton, Chara, Ranuncullus, Ceratophyllum, Myriophyllum, Nitella, and Nuphar was subjected to matrix analysis. In the area studied the presence or absence of a taxon does not appear to be a question of prior introduction in a specific river of but whether the habitat is suitable for growth. Certain habitat characteristics showed definite relationships to heavy macrophyte growth. Of the five land use catagories, irrigated agriculture sagebrush-grazed, and near population centers had the highest percentages of heavy growth sites 53.3%, 42.7%, and 47.9% respectively, suggesting a strong relationship between macrophyte abundance and land disturbance of the soil. Of significance is the fact that those taxa found causing heavy growth in the study area were also found in rare or sparse densities in other locations. Excessive development of lake banks may encourage littoral vegetation through the formation of shallow areas since eroded soil of the banks supply necessary nutrients for growth and a substrate for anchoring plant roots. Percolation through soil removes solids from pasture runoff, irrigation wastes, septic tank wastes, etc and stimulate prolific macrophytic growth in near shore water. Aquatic weed problems were most common at lower altitudes and higher temperatures. (See also W91-12922) (Doyle-PTT)
W91-12932

DISSIPATION OF 2,4-D RESIDUES IN LARGE RESERVOIRS.
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 5B.
W91-12934

'GIANT' BLUE-GREEN ALGA.
Clemson Univ., SC. Dept. of Biological Sciences.
For primary bibliographic entry see Field 4A.
W91-12938

2I. Water In Plants

COMPARISON BETWEEN DRIP AND FURROW IRRIGATION IN COTTON AT TWO LEVELS OF WATER SUPPLY.
Direccion General de Investigacion y Extension Agrarias, Cordoba (Spain). Dept. de Suelos y Riegos.
For primary bibliographic entry see Field 3F.
W91-11609

GROWTH RATE AND WATER USE BY LEGUME SPECIES AT THREE SOIL TEMPERATURES.
Colorado State Univ., Fort Collins.
J. A. Zachariassen, and J. F. Power.
Agronomy Journal AGJOAT, Vol. 83, No. 2, p 408-413, March/April 1991. 1 fig, 5 tab, 11 ref.

Descriptors: *Beans, *Clovers, *Legumes, *Plant growth, *Soil temperature, *Soil-water-plant relationships, *Soybeans, *Vetch, *Water use efficiency, Cover crops, Nitrogen fixation.

Legumes may be used to reduce fertilizer inputs, provide ground cover for soil erosion protection, and reduce residual soil nitrates. Little data are available to guide a producer in selecting a legume that matches water and temperature conditions and produces acceptable growth and nitrogen-fixation rates. An experiment was undertaken to provide such information. After a 14-d germination period at 20 C, eight legume species were grown at soil temperatures of 10, 20, and 30 C for 105 d in a greenhouse. Daily water use was recorded, and plant dry weights were measured every 21 d. Initially annual species such as soybean (Glycine max) and fababean (Vicia faba) grew fastest at all temperatures. For the first 42 d at 10 C, white clover (Trifolium repens), crimson clover (T. incarnatum), and hairy vetch (V. villosa) also exhibited rapid growth. With warmer temperatures and longer growth periods, lespedeza (Lespedeza stipula) as well as soybean grew rapidly. At 20 and 30 C, soybean growth was often more than double that of most other species. Growth was maximal at 10 C for fieldpea (Pisum arvense), hairy vetch, and crimson clover; at 20 C for fababean and white clover; and at 30 C for soybean, sweetclover (Melilotus alba) and lespedeza. Average water-use rates and water-use efficiency generally paralleled growth, except water use increased and water-use efficiency decreased as soil temperature increased. These results indicate that growth and water use differed greatly among legume species, that each legume species has its own characteristic optimum growth temperature, and that this optimum temperature for a given species may change as growth progresses. (Author's abstract)
W91-11613

YIELD RESPONSE OF GROUNDNUTS TO THE AMOUNT AND TIMING OF WATER APPLICATION.
International Center for Agricultural Research in the Dry Areas.
For primary bibliographic entry see Field 3F.
W91-11654

LIMITING SUPPLEMENTAL IRRIGATION IN THE DELTA STATES: IMPACT ON NET RETURN AND CROPPING PATTERNS.
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Economics and Agribusiness.
For primary bibliographic entry see Field 3F.
W91-11655

NITROGEN EFFECTS ON SOIL WATER EXTRACTION BY TALL FESCUE IN NORTHERN APPALACHIA.
Agricultural Research Service, University Park, PA. Regional Pasture Research Lab.
For primary bibliographic entry see Field 3F.
W91-11754

USE OF CERTAIN PLANT PARAMETERS TO DETERMINE THE PROFILE AVAILABLE WATER CAPACITY OF DURUM WHEAT AT DIFFERENT GROWTH STAGES.
Fort Hare Univ., Alice (South Africa). Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W91-11772

DEVELOPMENT OF WATER POTENTIAL GRADIENTS IN NON-ROOTED AGGREGATES IN RELATION TO AGGREGATE SIZE AND RELATIVE HUMIDITY OF THE AIR.
Hanover Univ. (Germany, F.R.). Inst. fuer Bodenkunde.
H. Bohne, and K. H. Hartge.
Soil and Tillage Research SOTRD5, Vol. 17, No. 3/4, p 231-240, September 1990. 8 fig, 9 ref.

Descriptors: *Plant-water relationships, *Relative humidity, *Soil water, *Soil-water-plant relationships, *Water potentials, Clays, Soil properties, Water loss.

In pot experiments with rye-seedlings, it was investigated how the size of non-rooted artificially made spherical aggregates influences the development of water potential gradients in the aggregates and the utilization of water. The experiments were carried out with constant low (40%) and high (70%) relative humidity, and with changing low (40-60%) and high (70-90%) relative humidity. Material from a clay soil (52% < 2 microm) was used. The mean gradient of water potential developing in the aggregates during the course of drying increased with decreasing aggregate size. For constant relative humidity, loss of water from the aggregates increased with increasing mean gradient of water potential. For changing relative humidity, loss of water from the aggregates was independent of the mean gradient of water potential and hence from aggregate size. It was determined that the change in relative humidity allows a certain redistribution of water in the aggregates which makes the water in the center of large aggregates accessible to roots. (Author's abstract)
W91-12526

HEAT SHOCK PROTEIN EXPRESSION IN THERMOTOLERANT AND THERMOSENSITIVE LINES OF COTTON.
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
M. A. O'Connell.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-145210. Price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces Technical Completion Report No. 246, November 1989. 30p, 6 fig, 44 ref. State Project 1345680.

Descriptors: *Biotechnology, *Plant stress, *Water use efficiency, Cotton, Electrophoresis, Heat shock proteins, Heritable thermotolerance, Plant thermotolerance.

A large proportion of the water absorbed by a plant is used to cool its leaves as the air temperature becomes too hot. If the molecular basis of heritable thermotolerance were understood, then improvements in water use by crop plants might be possible. The role of heat shock proteins (HSPs) in the expression of heritable thermotolerance in cotton was investigated. Comparisons were made between the expression of HSPs in genetically characterized heat-tolerant and heat-sensitive lines of cotton. These comparisons were based on electrophoretic analysis of in vivo labelled proteins. No differences were observed between the two lines with regard to (1) the temperature at which HSP synthesis was induced (37 C), or the temperature at which HSP synthesis was maximal (45 C); (2) the rates of recovery from HSP synthesis or in the duration of HSP synthesis; and (3) the major size classes of HSPs expressed in these two lines. Several unique HSPs were identified on two-dimensional gels; a 26 kDa HSP which was expressed in the tolerant cotton line and a 24 kDa and an 18 kDa HSP which were expressed in the sensitive cotton line. However, the HSP pattern displayed in a heat-tolerant BC3 individual was that of the heat sensitive parent. No alteration in HSP expression could be found which correlated with the heritable thermotolerance. (USGS)
W91-12631

2J. Erosion and Sedimentation

COMPARISON OF GRAIN SIZE CORRECTION PROCEDURES FOR ORGANIC MICROPOLLUTANTS AND HEAVY METALS IN MARINE SEDIMENTS.
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
For primary bibliographic entry see Field 5A.
W91-11635

VALIDATION OF THE UNIVERSAL SOIL LOSS EQUATION FOR THREE CROPPING SYSTEMS UNDER NATURAL RAINFALL IN SOUTHEASTERN QUEBEC.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
F. Salehi, A. R. Pesant, and R. Lagace.
Canadian Agricultural Engineering CAEOAI, Vol. 33, No. 1, p 11-16, January 1991. 3 fig, 4 tab, 12 ref.

Descriptors: *Cropland, *Erodibility, *Soil erosion, *Universal soil loss equation, Canada, Corn, Loam, Podzols, Quebec, Rainfall, Sandy soils.

A natural rainfall plot experiment conducted during the growing season at the Lennoxville Research Station, located in the rolling hills of the Southern Appalachian region of Quebec, was used to validate the Universal Soil Loss Equation (USLE) for three different cropping systems grown on a tile-drained sandy loam (Humo Ferric Podzol) with a 9% slope. Values for soil erodibility, and seasonal and annual cover and management factors under permanent pasture, no-till and conventional corn systems were assessed for three cropstage periods: seedbed, establishment, and development and maturing. A strong relationship between rainfall erosivity index and the soil losses indicated that the USLE erosivity factor characterizes the erosive action of the rainfall and the validity of the USLE for long term prediction. The USLE was thus found to be valid for this particular region of Quebec to predict soil erosion losses during the growing season. (Author's abstract)
W91-11648

PERFORATION DIMENSIONS AND EXIT HYDRAULIC GRADIENT EFFECTS ON SEDIMENTATION IN SUBSURFACE DRAINS.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 8B.
W91-11649

RELATIONSHIPS BETWEEN TROPHIC ORGANIZATIONS OF BENTHIC COMMUNITIES AND ORGANIC MATTER CONTENT IN TYRRHENIAN SEA SEDIMENTS.
Comitato Nazionale per l'Energia Nucleare, La Spezia (Italy).
For primary bibliographic entry see Field 2L.
W91-11688

RELATIONSHIP OF SOIL AND PLANT CHARACTERISTICS TO EROSION AND RUNOFF ON PASTURE AND RANGE.
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
L. Hofmann, and R. E. Ries.
Journal of Soil and Water Conservation JSWCA3, Vol. 46, No. 2, p 143-147, March/April 1991. 5 tab, 26 ref.

Descriptors: *Erosion, *Erosion control, *Pastures, *Rangeland, *Runoff, *Soil erosion, Erodibility, Grazing, Groundcover, Mathematical equations, Roots, Soil properties, Soil water, Vegetation effects.

Most soil loss equations for pasture and rangeland have been developed using data from studies conducted on cropland. This study was conducted to further determine relationships of soil and vegetation factors to soil loss and water runoff from reclaimed pastures and rangeland. Simulated rainfall was applied, using a sprinkler-head grid system at a rate of 46 mm/h (1.8 in/h), to 4.0 m x 22.1 m (13 x 72 ft) plots on reclaimed mined and native Cabba and Sen soils. Treatments included reclaimed heavily, moderately, and lightly grazed pastures; reclaimed burn; reclaimed ungrazed; native grazed; native burn; and native ungrazed runoff plots. Percent bare ground was the most important factor explaining soil loss. As ground cover increased, soil sediment in the runoff decreased because of less soil detachment. Total vegetative dry matter was the most important factor explaining runoff. Vegetation and ground cover were related highly to soil loss and runoff factors, whereas soil bulk density, soil water, root weight, soil aggregation, and soil particle size generally were not. Vegetation and ground cover factors and soil bulk density and root weight were related to runoff. Vegetation and surface soil factors were of major importance in explaining soil erosion on rangeland compared to subsoil factors generally associated with soil erodibility on cropland. These findings deserve consideration as equations are developed for predicting soil loss and runoff from pastures and rangeland. (Author's abstract)
W91-11752

INCISION AND MORPHOLOGIC EVOLUTION OF AN ALLUVIAL CHANNEL RECOVERING FROM HYDRAULIC MINING SEDIMENT.
South Carolina Univ., Columbia. Dept. of Geography.
L. A. James.
Geological Society of America Bulletin BUGMAF, Vol. 103, No. 6, p 723-736, June 1991. 16 fig, 3 tab, 89 ref.

Descriptors: *Alluvial channels, *Channel erosion, *Channel morphology, *Environmental effects, *Incised rivers, *Mining, *Sediment transport, *Sedimentation, California, Channel improvement, Floods.

Hydraulic gold mining in the Sierra Nevada, California, produced such a large volume of sediment from 1853 to 1884 that channels could not carry a substantial proportion of the delivered sediment. The lower Bear River aggraded as much as 5 m and underwent a major avulsion during the 1870s. Channel morphology continues to respond to these changes more than 100 years after the cessation of most hydraulic mining. Textures of mine tailings and older alluvium are contrasted, and channel incision and channel-shape changes from 1930 to 1985 are documented. Unlike the Yuba and Sacramento Rivers, the lower Bear River had not returned to premining base levels by 1950 as sediment loads decreased. Nor were incision rates or morphological change governed by reduced sediment loads below dams built in 1928 and in the mid-1960s. Channel stability was due to resistance of a cohesive stratum on the channel bed. An episode of channel down-cutting was instigated by a moderately large flood in December 1955 that pierced the cohesive layer and was sustained through the 1970s by moderate-magnitude floods. The 1955 flood did not directly erode large volumes of sediment, but is destabilized the channel, allowing smaller floods to erode the channel at an accelerated rate. Episodic channel-bed incision is contrasted to progressive morphologic changes. Cross-section shape narrowed and deepened steadily from 1930 through the mid-1970s as the channel was superimposed onto cohesive older alluvium. Progressive deepening set up a positive feedback that ensured the ultimate penetration of the paved bed. Channel morphologic readjustment from the avulsion thus was both progressive and episodic. (Author's abstract)
W91-11786

EFFECTS OF ROOT REINFORCEMENT ON SOIL-SLIP PATTERNS IN THE TRANSVERSE RANGES OF SOUTHERN CALIFORNIA.
California Univ., Los Angeles. Dept. of Geography.
For primary bibliographic entry see Field 4D.
W91-11787

COAST EROSION MANAGEMENT--THE KELANTAN CASE.
Waterloopkundig Lab. te Delft, Emmeloord (Netherlands). De Voorst Lab.
For primary bibliographic entry see Field 4D.
W91-11798

APPLICATION OF 210-PB-METHOD TO SHALLOW WATER ENVIRONMENTS, (IN CHINESE).
East China Normal Univ., Shanghai. Inst. of Estuarine and Coastal Research.
W. Chen, J. Shen, D. Eisma, and G. W. Berger.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 21, No. 6, p 529-535, November 1990. 4 fig, 1 tab, 4 ref. (English summary).

Descriptors: *Coastal waters, *Lead radioisotopes, *Radioactive dating, *Sedimentation, *Shallow water, *Tidal flats, *Wadden Sea, Germany, Jade Bay, Sediment transport, The Netherlands, Water level.

Some problems were encountered when 210-Pb activity was measured in tidal flat sediments from the Waddensea, The Netherlands. The 'transfer time' and 'settling time' of 210-Pb were derived to analyze the relationships between sediment movement and 210-Pb activity in the sediments. Factors influencing initial 210-Pb activities were: (1) the input amount of 210-Pb per unit time from the atmosphere into the waters; (2) the pattern of sediment movement and the time during which particles were suspended in the water; and (3) sediment grain size. The 210-Pb profiles were examined with respect to the relationship between 210-Pb activity and sediment texture. Recent sedimentation rates were found to be 0.16 to 0.29 cm/a in the tidal flats of Jade Bay, 0.16 cm/a in the tidal flats near Greetsiel, Germany, and 6.0 cm/a near Afsluitdfijk, The Netherlands. Recent sediment accumulation in the tidal flats of Jade Bay keep pace with the sea level rise. (Author's abstract)
W91-11800

PRELIMINARY MAP SHOWING LOCATIONS OF LANDSLIDES IN EL YUNQUE QUADRANGLE, PUERTO RICO.
Geological Survey, San Juan, PR. Water Resources Div.
M. R. Guariguata, and M. C. Larsen.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225. USGS Open-File Report 89-257, 1990. 1 map (sheet), 1 tab, 10 ref. Prepared in cooperation with the Puerto Rico Planning Board.

Descriptors: *Landslides, *Maps, *Puerto Rico, Aerial photography, Highway effects, Mapping, Mass wasting, Rainfall.

A preliminary landslide location map was prepared as part of a U.S. Geological Survey investigation of landslide hazards in Puerto Rico in cooperation with the Puerto Rico Planning Board. The preliminary observations were based on examination of aerial photography (1936, 1951, 1964, 1972, 1979, 1986, and 1988) and field surveys performed in 1988 and 1989. On the basis of the time intervals between sequential photographic sets, seven age classes were developed; most of the mapped landslides are active, and the ages given are for the earliest estimated date of the failure. Of the 173 landslides mapped, all but 20 were field-verified; there are 107 landslides associated with highway construction and 66 natural landslides on forested slopes. Landslides are a common phenomena in the Caribbean National Forest and normally occur during periods of high rainfall. The landslides remove from 1 to 3 m of soil and saprolite and a few massive debris have removed more than 8 m of material from the slopes. The maximum areas for highway-associated and natural landslides are 44,000 and 5,000 sq m, respectively. The majority of both natural and highway-associated landslides are found in the area of the Rio Blanco stock; this may indicate a substantial lithologic control for landslides. (Fish-PTT)
W91-11837

SEDIMENT DISCHARGE IN FORTIFICATION CREEK AND THE EFFECT OF SEDIMENTATION RATE ON THE PROPOSED RAMPART RESERVOIR, NORTHWESTERN COLORADO.
Geological Survey, Grand Junction, CO. Water Resources Div.
D. L. Butler, R. O. Hawkinson, and R. W. Boulger.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4103, April 1991. 22p, 9 fig, 5 tab, 17 ref.

Descriptors: *Bed load, *Colorado, *Reservoir silting, *Sediment transport, *Sedimentation rates, *Suspended sediments, Regression analysis, Reservoir sites.

Estimates are presented of the sediment discharge in Fortification Creek and the sedimentation rate of the proposed Rampart Reservoir located in northwestern Colorado. Suspended-, and bedload-sediment data collected on 31 days during water years 1986 and 1987 were used to estimate sediment discharge from stream discharge for the proposed reservoir site. Regression relations based on seasons of the year were developed for suspended-sediment discharge. Stream discharge was record-

ed only since water year 1985 at the Fortification Creek streamflow-gaging station where the sediment data were collected. A record extension technique was used to simulate stream discharge for Fortification Creek for water years 1954-84. The estimated mean annual suspended-sediment discharge in Fortification Creek at the gaging station was 17,800 tons for water years 1954-87. Bedload discharge was estimated to account for 2% of the total sediment discharge; therefore, the estimated mean annual total-sediment discharge for the same period was 18,200 tons. The gaging station is downstream from the proposed damsite; therefore, the mean annual total-sediment discharge used to compute the sedimentation rate of the reservoir was assumed to be equal to 90% of the mean annual total-sediment discharge at the gaging station, or 16,400 tons. At that rate, the reservoir storage capacity would decrease from 12,133 to about 11,000 acre-ft after 100 years at 100-percent trap efficiency. Using the 95% confidence interval of the mean annual total-sediment discharge, the storage capacity would range from about 9,900 to 11,500 acre-ft after 100 years. (USGS)
W91-11947

SEISMIC REFLECTION INVESTIGATION OF KALAMALKA LAKE: A 'FIORD LAKE' ON THE INTERIOR PLATEAU OF SOUTHERN BRITISH COLUMBIA.
Syracuse Univ., NY. Dept. of Geology.
H. T. Mullins, N. Eyles, and E. J. Hinchey.
Canadian Journal of Earth Sciences CJESAP, Vol. 27, No. 9, p 1225-1235, 1990. 10 fig, 28 ref.

Descriptors: *Geomorphology, *Glacial lakes, *Glaciation, *Kalamalka Lake, *Sedimentation, *Seismic surveys, *Stratigraphy, Bedrock, British Columbia, Fjords, Glacial sediments, Glaciohydrology, Lake basins, Lake sediments.

A uniboom seismic reflection profile survey has revealed the nature of bedrock relief and the acoustic character of Pleistocene glacial sediment fill beneath Kalamalka Lake in southern British Columbia. Despite its continental interior setting, Kalamalka Lake basin has many attributes of coastal fjords, such as being overdeepened below sea level, having closed bedrock depressions, and a thick sediment fill. The bedrock surface beneath Kalamalka Lake has been eroded as much as 417 m below lake level (26 m below sea level) and is characterized by a series of closed, glacially overdeepended depressions. This profile suggests that the location of the lake basin is structurally controlled, but was overdeepened by rapidly flowing ice that drained the interior portions of the Cordilleran ice sheet during repeated Pleistocene glaciation. Up to 272 meters of sediment has been deposited in the lake basin. The thickest portion of the sediment fill (up to 237 m) is a seismically transparent unit that overlies a thin (up to 20 m), discontinuous stratified unit and underlies a continuous, well-stratified upper unit. The sedimentological nature of the lower stratified unit may represent a discontinuous coarse lag. The thick, middle unit is interpreted as a massive silt deposit resulting from suspended sediment plumes during deglaciation. The thin overlying unit may be correlated with laminated glaciolacustrine 'white silt' deposits that outcrop extensively across central and southern British Columbia, suggesting a common history of deglaciation and sedimentation. (Author's abstract)
W91-11977

SITE-SPECIFIC EROSIVITY OF A SIERRA NEVADA FORESTED WATERSHED SOIL.
Nevada Univ., Reno. Dept. of Range, Wildlife and Forestry.
D. G. Guerrant, W. W. Miller, C. N. Mahannah, and R. Narayanan.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 396-402, 1991. 5 fig, 5 tab, 30 ref.

Descriptors: *Erodibility, *Erosion, *Forest soils, *Forest watersheds, *Runoff, *Sierra Nevada Mountains, *Soil erosion, Infiltration, Infiltration rate, Model studies, Regression analysis, Slopes, Tahoe Basin.

Little quantitative site-specific infiltration, runoff, and erosion data for forested watershed soils of the Tahoe Basin are available. A Modular-type rainfall simulator was used to examine these variables for the Cagwin (mixed Typic Cryopsamment) soil series. Three slope (0-15, 15-30, >30%) and four plot conditions (undisturbed with natural duff, undisturbed without natural duff, disturbed without natural duff, and disturbed with natural duff removed) were studied. Infiltration and runoff data were incorporated into a modified Philip's model whereas erosion data were incorporated into a general nonlinear model. Data sets were analyzed via nonlinear regression for slope and plot interaction. Slope had negligible effect on infiltration and runoff but had a significant effect on erosion. Plot condition had significant effects on infiltration, runoff, and erosion. Final infiltration rates ranged from 4.7 to 6.1 cm/h, runoff ranged from 36 to 59% of the application rates, and cumulative interrill erosion ranged from 37.5 to 108.4 g/sq m for a simulated design storm of 8 to 10 cm/h. The findings of this investigation were consistent with those of related quantitative investigations and indicate that the Cagwin soil has a low relative erosivity. Data from this study further suggest that previously applied models used to estimate potential erosion hazards of forested watershed soils may well result in over-estimation of erosion potential. (Author's abstract)
W91-11998

SEDIMENT CONCENTRATION OF INTERRILL RUNOFF UNDER VARYING SOIL, GROUND COVER, SOIL COMPACTION, AND FREEZING REGIMES.
Agriculture Canada, Charlottetown (Prince Edward Island). Research Station.
L. M. Edwards, and J. R. Burney.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 403-407, 1991. 6 fig, 3 tab, 10 ref.

Descriptors: *Erosion, *Freezing, *Rill erosion, *Runoff, *Sediment transport, *Soil erosion, *Soil properties, *Vegetation effects, Canada, Ground cover, Loam, Prince Edward Island, Regression analysis, Rye, Soil compaction, Soil types, Straw, Thawing.

Soil concentration (SC) of runoff was measured from three Prince Edward Island, Canada, soils (loam, sandy loam, and fine sandy loam surface texture) subjected to laboratory rainfall simulation to assess the effect of ground cover (winter rye or straw), soil compaction, and freezing (10 days' continuous freeze or daily freeze/thaw). Sediment concentration for the loam was 47 and 50% greater than the other soils. Straw cover gave SC of 23% < bare surface, and winter rye 25% < bare surface. Freezing treatment had no first-order effect on SC but interacted with soil type and with ground cover. The loam showed 30% greater SC based on lower runoff volume with daily freeze/thaw than with continuous freeze. Freeze/thaw resulted in a 54% greater SC than continuous freeze. Freeze/thaw caused numerous surface cracks in the soil and enhanced internal drainage, thus resulting in less runoff than continuous freeze. A regression analysis of the relationship between SC and winter rye cover showed that variations in SC were dominated, 53% by sediment mass (compared with 18% by runoff volume). Variations in rye cover were dominated, 49%, by leaf area (compared with 8% by leaf mass and 5% by root mass). Although this study found increasing SC to occur with subsurface soil compaction for all three soils, and the loam to be particularly susceptible to daily freeze/thaw, any adverse impact of these factors on erosion or erosion control was minimized with the use of winter rye or straw as ground cover. (Author's abstract)
W91-11999

ANAEROBIC MICROBIAL BIOGEOCHEMISTRY IN SEDIMENTS FROM TWO BASINS IN THE GULF OF MAINE: EVIDENCE FOR IRON AND MANGANESE REDUCTION.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 2K.
W91-12043

SOME OBSERVATIONS ON THE EFFECT OF VERTICAL DENSITY GRADIENTS ON ESTUARINE TURBULENT TRANSPORT PROCESSES.
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W91-12045

SCOUR DOWNSTREAM OF GRADE-CONTROL STRUCTURES.
Gonzaga Univ., Spokane, WA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-12052

DRAG COEFFICIENT AND FALL VELOCITY OF NONSPHERICAL PARTICLES.
Roorkee Univ. (India). Dept. of Civil Engineering.
P. K. Swamee, and C. S. P. Ojha.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 660-667, May 1991. 4 fig, 4 ref.

Descriptors: *Drag, *Fall velocity, *Particulate matter, *Sediment transport, *Sedimentation, Graphical analysis, Mathematical equations, Model studies.

The most commonly encountered particles in the areas of sediment transport, fluidization, and sedimentation are nonspherical. The role of these particles can be ascertained only through the knowledge of drag coefficient and fall velocity. Graphical relationships for the determination of drag coefficient and fall velocity are available in the literature. The graphical relationships are less accurate because they are subject to errors of judgment. Furthermore, these relationships cannot be used for any analytical purposes. Based on previously collected data for the drag coefficient and fall velocity of nonspherical particles, empirical equations for the drag coefficient and fall velocity of nonspherical particles of natural and mechanical origin were derived from curve fittings. These equations should be useful in the analytical modeling of various engineering problems involving fluid-nonspherical particle interaction. (Doria-PTT)
W91-12057

DISCHARGE OF DISSOLVED AND PARTICULATE 137-CS IN THE KUJI RIVER, JAPAN.
Japan Atomic Energy Research Inst., Tokai. Environmental Radiochemistry Lab.
T. Matsunaga, H. Amano, and N. Yanase.
Applied Geochemistry APPGEY, Vol. 6, No. 2, p 159-167, 1991. 12 fig, 3 tab, 29 ref.

Descriptors: *Cesium radioisotopes, *Environmental tracers, *Fallout, *Kuji River, *Path of pollutants, *Sediment transport, *Tracers, Air pollution, Chemical speciation, Dissolved solids, Japan, Particulate matter, Precipitation, Radioactivity, Water sampling.

The discharge of fallout 137-Cs in the water of the Kuji River (Japan) was studied to gain a better understanding of the migration behavior of 137-Cs in the river watershed. Under normal flow conditions, the radioactivity of dissolved 137-Cs in the water ranged from 0.05 to 0.12 mBq/L, while that of particulate 137-Cs ranged from 0.02 to 0.09 mBq/L. A large increase in particulate 137-Cs, (up to 0.77 mBq/L), was observed under high flow conditions caused by a 40 mm precipitation event. The dominant pattern of speciation of 137-Cs was from the dissolved to the particulate mode depending upon the flow conditions at the time of the precipitation event. The annual budget of 137-Cs in the watershed was estimated based on this empirical relationship between the load of 137-Cs and the flow rate. The accumulated load of 137-Cs in the watershed was determined to be 4200 MBq/sq km; annual losses were 1.7 MBq/sq km through discharge into the river, and 100 MBq/sq km by radioactive decay. This budget has proven, qualitatively, that the surface soil acts as a significant

adsorbent for atmospherically derived 137-Cs. (Author's abstract)
W91-12130

DYNAMIC SEDIMENTATION PROCESSES IN A GLACIER-FED LAKE, PEYTO LAKE, ALBERTA, CANADA.
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
K. Chikita, N. Yonemitsu, and M. Yoshida.
Japanese Journal of Limnology RIZAAU, Vol. 52, No. 1, p 27-43, January 1991. 14 fig, 1 tab, 23 ref.

Descriptors: *Glacial lakes, *Lake sediments, *Peyto Lake, *Sedimentation, Alberta, Clays, Silt, Suspended sediments, Turbidity, Wind-driven currents.

Physical sedimentation in glacier-fed Peyto Lake, Alberta was examined for the ice melting period of 1987, by measuring lake currents, suspended sediment concentration and water temperature. During the observation period of June-August, the heavy sediment discharge of an inflow river, Peyto Creek, continuously induced sediment plumes in a surface layer of the lake and turbidity currents in the bottom layer. Their offshore conservative behaviors are basically due to the slow settling of input fine sediment (silt and clay > 70 wt %). The bottom water, which has a both a high velocity and sediment concentration, was longitudinally observed as the bottom currents flowed from near the inflow river mouth to the outflow river mouth. Noting a difference in the driving force of bottom sedimentary flows, the results may be explained by: (1) 'turbidity currents,' driven by the downslope gravity force, flowed down to the deepest region of the southern sub-basin, bounded by a subaqueous sill in the central part of the lake; (2) 'bottom suspension flows,' probably induced by strong wind driven currents, subsequently flowed on the upslope of the sill, while suspending the sediment transported by the turbidity currents, and consequently passing over the sill; and (3) turbidity currents weakened by sediment deposition flowed on the downslope toward the deepest region of the distal northern sub-basin. The possibility that wind driven currents act as a driving force for suspension flow is supported by the specific spatial distribution of the sedimentation rate for sediments trapped near the bottom. The shear force of turbidity currents and suspension flows is numerically determined by applying the drag law at boundaries. The depositional and erosional conditions of suspended and bottom sediments, transported by the two sedimentary flows, can then be examined by using the 'extended Shields diagram' in which an experimental result of sediment deposition is considered. (Author's abstract)
W91-12177

TRANSPORT AND RETENTION OF PARTICULATE ORGANIC MATTER IN TWO LOW-GRADIENT HEADWATER STREAMS.
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
J. B. Jones, and L. A. Smock.
Journal of the North American Benthological Society JNASEC, Vol. 10, No. 2, p 115-126, June 1991. 7 fig, 2 tab, 35 ref. NSF Grant Nos. BSR-8315763 and BSR-8614828.

Descriptors: *Buzzards Branch, *Colliers Creek, *Headwaters, *Organic matter, *Particulate matter, *Sediment transport, Coastal plains, Detritus, Flooding, Flow discharge, Seasonal variation, Streamflow, Virginia.

Transport and retention of particulate organic matter (POM) were examined in the channels and on the floodplains of two low-gradient headwater streams on the Coastal Plain of southeastern Virginia. During base discharge, POM was primarily retained as it settled onto the sediment surface, but during high discharge, debris dams became primary retainers. During over-bank flooding, much of the coarse particulate organic matter (CPOM) moved from the channels onto the floodplains. The mean distance that wood moved over a year at Colliers Creek, which had low current velocity and a broad, frequently inundated floodplain, was 23 m in the channel and 46 m on the floodplain; at Buzzards Branch, with higher current velocity and a smaller, less-frequently inundated floodplain, wood moved a mean distance of 136 m in the channel and only 2 m on the floodplain. Mean leaf transport distances in the channels ranged from 1.6 m in Colliers Creek during summer base discharge to 156 m at Buzzards Branch during a winter spate; mean leaf transport distances on the floodplains were 0.5-1.7 m. Fine particulate organic matter (FPOM) transport, studies only during base discharge, was farther than that of wood or leaves and varied from 1.8 m during summer base discharge in the Colliers Creek channel to 84.0 m during winter base discharge in the Buzzards Branch channel. Over one year, 97% and 27% of the marked wood placed in the channels was transported into the Colliers Creek and Buzzards Branch floodplains, respectively; only 14-9% of the marked wood placed in the floodplains moved into the channels. Base flow flux of POM was 24,000 kg/yr and 1700 kg/yr on the floodplains, and 7000 kg/yr and 13,000 kg/yr in the channels, at Colliers Creek and Buzzards Branch, respectively. Retention, transport distance, and magnitude of POM exchange between the channels and floodplains were dependent on the timing, frequency and extent of spates, and floodplain inundation, which thus were critical determinants of POM dynamics and hence, system structure and function. (Author's abstract)
W91-12179

INFLUENCE OF NUTRIENTS AND GRAZING ON THE RESPONSE OF STREAM PERIPHYTON COMMUNITIES TO A SCOUR DISTURBANCE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2E.
W91-12180

TRANSPORT OF COARSE PARTICULATE ORGANIC MATTER IN AN IDAHO RIVER, USA.
Idaho State Univ., Pocatello. Dept. of Biological Sciences.
T. R. Angradi.
Hydrobiologia HYDRB8, Vol. 211, No. 3, p 171-183, March 29, 1991. 9 fig, 42 ref.

Descriptors: *Detritus, *Idaho, *Particulate matter, *Sediment transport, *Snake River, Aquatic drift, Aquatic plants, Organic matter, Primary productivity, Seasonal variation.

Organic matter transport was investigated in the Henry's Fork of the Snake River, Idaho, from August 1987 to November 1988. Mean discharge during the study was 15 cu m/sec. Screens were used to sample very coarse (> 6mm) transported aquatic macrophyte material (VCTMM). Drift nets were used to sample coarse (1-6 mm) and fine (0.25-1 mm) transported particulate matter (CTOM and FTOM). Mean monthly concentration of VCTMM was 0.064 mg ash-free dry weight (AFDW)/l and was significantly higher than CTOM (0.024 mg AFDW/l) and FTOM (0.036 mg AFDW/l). VCTMM concentration was highest in December (0.163 mg AFDW/l) and lowest in May (0.018 mg AFDW/l). The sample position along a transect across the channel had a significant effect on the amount of transported organic matter collected in many months. The concentration of debris from individual species tracked the standing stock of that species during the growing season. In autumn, a dramatic increase in VCTMM corresponded to a decrease in macrophyte standing stock. FTOM and CTOM concentrations were highest in January (CTOM: 0.048; FTOM: 0.111 mg AFDW/l), lowest in November (< 0.006 mg AFDW/l), were not correlated with discharge, and were inversely correlated with the standing stocks of macrophytes upstream, probably because macrophyte beds influenced the retentiveness of the channel. Standing stock of aquatic macrophytes was highest in September-October (5.2 kg wet weight/sq m) and lowest in February (1.7 kg wet weight/sq m). Annual movement of particulate matter past the sampling point was about 45,000 kg AFDW, of which 21,000 kg was VCTMM, 8000 kg was coarse particulate organic matter, and 16,000 was fine particulate organic matter. (Author's abstract)
W91-12192

STOCHASTIC DISTRIBUTED MODEL OF SOIL EROSION BY OVERLAND FLOW.
Silsoe Coll. (England).
A. C. Wright, and R. Webster.
Earth Surface Processes and Landforms ESPLDB, Vol. 16, No. 3, p 207-226, May 1991. 16 fig, 25 ref.

Descriptors: *Computer models, *Erosion, *Model studies, *Overland flow, *Runoff, *Soil erosion, Conductivity, Particle size, Porosity, Rills, Storage capacity, Surface water, Topsoil.

A model has been developed to simulate runoff and erosion on slopes of varying form with soil of varying hydraulic conductivity, porosity, storage capacity, and particle size distribution. The model is based on known physical laws and takes into account spatially dependent random variation in the initial conditions of the soil. The rain is similarly both random and autocorrelated in space. The erosion model is able to calculate the runoff both by determining rise in the water table as a result of infiltration and any excess of rainfall over infiltration when only the surface of the soil is saturated. Results showed that runoff is generated as a result of slow conductivity and high water table, which leads to erosion, the degradation of the land surface, the capture of flow lines, and the development of networks of rills. The patterns of rills that develop as the model runs accord remarkably well with those obtained in previous laboratory experiments. The model responded realistically to changes in the input variables. However, these trials were by no means exhaustive. The model in its present form applies only to disaggregated soil or to soil with aggregrates that are loose and fine. Much of the cultivated topsoil in the world is like this, making the model potentially relevant in many instances. (Mertz-PTT)
W91-12262

NEOTECTONIC EFFECTS ON SINUOSITY AND CHANNEL MIGRATION, BELLE FOURCHE RIVER, WESTERN SOUTH DAKOTA.
Indiana State Univ., Terre Haute. Dept. of Geography and Geology.
B. Gomez, and D. C. Marron.
Earth Surface Processes and Landforms ESPLDB, Vol. 16, No. 3, p 227-235, May 1991. 4 fig, 23 ref.

Descriptors: *Alluvial channels, *Channel morphology, *Channel stability, *Geomorphology, *Sinuous flow, *Streamflow, *Watercourses, Belle Fourche River, Black Hills, Channels, Flood plains, South Dakota, Streamflow data, Streamflow forecasting, Tectonics.

Short-term instability in the behavior of a small, meandering alluvial channel was identified from the relation between sinuosity and either floodplain slope or channel slope within 17 reaches along an 81-kilometer section of the Belle Fourche River in western South Dakota. In reaches 1 to 4 and 11 to 17 the channel was relatively stable and sinuosity varied inversely with channel slope. In reaches 5 to 10, sinuosity was positively related to floodplain slope. Sinuosity increased markedly in reaches 5, 6 and 7 (which were immediately downstream from a discontinuity in the long profile of the floodplain) in association with an increase in floodplain slope. Immediately upstream from the discontinuity, bankfull channel depth and sinuosity decreased and the area of the floodplain reworked by meander migration between 1939 and 1981 increased, in association with a decrease in floodplain slope. Channel behavior in reaches 5 to 10 was best explained as a consequence of neotectonic activity, as indicated by changes in elevation recorded along geodetic survey lines that cross lineaments that may delimit the eastern boundary of the Black Hills uplift. Sinuosity acts as a barometer of the effects of neotectonic activity on alluvial channels. Initial indications of channel and floodplain instability due to neotectonic activity may be derived from evidence of anomalously active channel mi-

gration, as documented from photographic or topographic sources. (Author's abstract)
W91-12263

RESULTS FROM A NEW MODEL OF RIVER BASIN EVOLUTION.
Newcastle Univ. (Australia). Dept. of Civil Engineering.
G. Willgoose, R. L. Bras, and I. Rodriguez-Iturbe.
Earth Surface Processes and Landforms ESPLDB, Vol. 16, No. 3, p 237-254, May 1991. 6 fig, 1 tab, 48 ref. National Science Foundation grant 8513556-ECE, Army Research Office grant DAAL03-89-K-0151, and National Weather Service cooperative research agreement NA86AA-H-HY123.

Descriptors: *Catchment areas, *Erosion, *Geomorphology, *Hydrologic models, *Model studies, *River basins, *Slope degradation, Channel erosion, Channels, Mathematical equations, Sediment transport, Slopes, Tectonics, Watersheds.

A model of the erosional development of catchments and their channel networks was developed. The model differentiates between the dominant transport processes in hillslope and channels. The development of channels and hillslopes occurs in an integrated manner as a function of physically observable mechanisms. The model was used to simulate a number of synthetic catchments and qualitative differences between catchments were noted. Dynamic equilibrium and transient nonequilibrium conditions were defined in the context of rates of change of the channel network and catchment elevations. It was demonstrated that at dynamic equilibrium, in catchments where fluvial sediment transport dominates, all catchments were similar, except for drainage density variations. Differences in tectonic uplift, runoff and erodability determined the prevailing slopes in the catchment and these differences did not influence the nondimensional catchment; they only changed the catchment vertical scale, the catchment slopes in this case. A reformulation of the elevation evolution equation into the form of an advection-diffusion equation demonstrated significant qualitative differences between the model presented here and most previously presented phenomenologically based hillslope evolution models. It is believed that these differences are conceptually significant and that in the case of one previously proposed model, the important phenomena of hillslope retreat could not be modelled. It was shown that the model led to very reasonable and desirable behavior of hillslopes during retreat and degradation. (Mertz-PTT)
W91-12264

SEDIMENT YIELD AND DELIVERY IN THE BLANKET PEAT MOORLANDS OF THE SOUTHERN PENNINES.
Huddersfield Polytechnic (England). Dept. of Geographical Sciences.
J. C. Labadz, T. P. Burt, and A. W. R. Potter.
Earth Surface Processes and Landforms ESPLDB, Vol. 16, No. 3, p 255-271, May 1991. 6 fig, 3 tab, 49 ref. NERC research studentship ref. GT4/83/AAPS/23.

Descriptors: *Erosion rates, *Peat bogs, *Sampling, *Sediment transport, *Sediment yield, Catchment areas, England, Peat soils, Reservoirs, Sediment distribution, Sediment load, Stream sampling.

Sediment transport on blanket peat moorland was investigated and short-term and long-term sediment yields were estimated. The research was conducted on Wessenden Head Moor to the west of Huddersfield, Yorkshire, England, where automatic stream sampling continued over a period of two years. Use of corrected rating curves provided a mean estimate of sediment yield over this period of 55 ton/sq km/yr. In addition, an estimate of longer-term sediment yield was derived from four reservoir sediment surveys in the Wessenden Valley. Total yield was 203.69 ton/sq km/yr, including an organic fraction of 38.82 ton/sq km/yr. Stream sampling at three sites on Shiny Brook, including headwaters and the outflow to the reservoir, suggested that there was great temporal and spatial variability in mineral and organic inputs to the reservoirs. Short-term study of sediment movement in streams indicated an average gravimetric yield, compared with other catchments in upland Britain, but the low density of peat means that relatively large volumes of peat are being removed. Longer-term yields from reservoir surveys produced a very similar sediment yield for the organic fraction; total sediment yields were much higher than those reported for other catchments in upland Britain. Although not excessive in gravimetric terms, the low density of peat means that there is a serious erosion problem. Major sources of sediment were probably overland flow and widespread (but minor) gravity collapse of the steep gully sides. Stream sampling showed, however, that erosion is by no means uniform in time and space. Estimates of erosion rates for the peat gully network at Shiny Brook appear to confirm earlier evidence concerning the relatively recent occurrence of this erosion, within the last two centuries. (Mertz-PTT)
W91-12265

COUPLED CHANNEL NETWORK GROWTH AND HILLSLOPE EVOLUTION MODEL: 1. THEORY.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 2E.
W91-12342

COUPLED CHANNEL NETWORK GROWTH AND HILLSLOPE EVOLUTION MODEL: 2. NONDIMENSIONALIZATION AND APPLICATIONS.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 2E.
W91-12343

PHYSICAL EXPLANATION OF AN OBSERVED LINK AREA-SLOPE RELATIONSHIP.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
G. Willgoose, R. I. Bras, and I. Rodriguez-Iturbe.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1697-1702, July 1991. 6 fig, 17 ref. NSF Grant 8513556-ECE, Army Research Office DAAL03-89-KK-0151, and National Weather Service Cooperative Research Agreement NA86AA-H-HY123.

Descriptors: *Channels, *Erosion, *Geomorphology, *Mathematical analysis, *Physical properties, *Slopes, Fluvial erosion, Geohydrology, Mathematical equations, Rain, Simulation analysis, Soil creep.

An observed log-log linear relationship between channel slope and contributing area is explained by the erosional physics that lead to catchment form. It was postulated that tectonic uplift is in balance with the fluvial erosion down-wasting that dominates catchment erosion, and that this relationship results in the observed log-log linear relationship at dynamic equilibrium. In addition, it was observed that there are deviations from this log-log linear relationship near the catchment divide, with observed slopes being lower than those predicted from the relationship. This was explained by noting that for small areas, fluvial erosion effects are dominated by soil creep and rain splash, modeled by diffusive physics. The area at which this deviation from log-log linearity occurs is that point on the hillslope at which diffusive physics, like soil creep and rain splash, begin to dominate fluvial erosion. These predictions are confirmed by numerical simulations using a catchment evolution model. (Author's abstract)
W91-12344

SEDIMENT DISCHARGE COMPUTATION USING POINT-SAMPLED SUSPENDED-SEDIMENT DATA.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. J. Ingram, S. R. Abt, and E. V. Richardson.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 6, p 758-773, June 1991. 7 fig, 21 ref, append.

Descriptors: *Data processing, *Sampling, *Sediment discharge, *Suspended sediments, Channels, Flow, Rivers, Sedimentation, Statistical analysis.

A procedure, TSD (total sediment discharge), was developed for computing total sediment discharge using point-sampled suspended sediment data. Comparison with field data from rivers in the Western United States indicates that the modified Einstein procedure (MEP) may provide greater reliability with a single depth-integrated suspended sediment sample than the TSD procedure with a single-point suspended sediment sample; the average of multiple TSD measurements is as reliable as a single MEP measurement. Moreover, a single TSD measurement is as reliable as a single MEP measurement. The TSD procedure was found reliable with point samples collected in the lower 20-45% flow depth. Point samples collected at locations further from the channel bed may provide less reliable measurements due to inadequacies in the assumed theoretical sediment concentration and flow velocity profiles. Point samples collected close to the channel bed may exhibit greater variance than other point samples due to the same processes that influence the stochastic nature of contact load transport. In particular, point samples may not be representative if they are collected near bed forms of a significant height. Advantages of the TSD procedure include realistic sediment discharge estimates, greater control in obtaining samples, automatic sampling, the collection of near-continuous measurements, and time integration for determining the true sediment transport. (Doria-PTT)
W91-12360

BED-LOAD AND SUSPENDED-LOAD TRANSPORT OF NONUNIFORM SEDIMENTS.
Roorkee Univ. (India). Dept. of Civil Engineering.
P. K. Swamee, and C. S. P. Ojha.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 6, p 774-787, June 1991. 8 fig, 15 ref.

Descriptors: *Bed load, *Mathematical equations, *Sediment transport, *Suspended load, Particle size, Sediment load, Sedimentation rates, Sediments, Shear stress.

Methods are available for the computation of bed load and suspended load transport rates of uniform sediments. However, the few studies on nonuniform sediments lack simplicity and often make use of various correction factors which must be read from a series of tables and graphs. This not only makes the evaluation cumbersome, but results in a loss of accuracy at each stage. Therefore, useful empirical equations for bed load and suspended load transport rates were developed for nonuniform sediments. As a special case, these equations faithfully describe the transport relations for uniform sediments. The nonuniformity of sediments is described by an empirical three-parameter grain-size distribution equation for unimodal shapes. A link between parameters of lognormal size distribution and the proposed size distribution was established. For low-shear-stress bed load transport rate, nonuniformity becomes unimportant and the equation for uniform bed material can be used. These proposed empirical equations for bed load and suspended load transport rates of nonuniform sediments are also useful for total-load transport rate computation. (Author's abstract)
W91-12361

EROSION OF COHESIVE BOTTOM SEDIMENTS: THE INFLUENCE OF BENTHOS.
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. F. Brekhovskikh, V. K. Debolsky, G. N. Vishnevskaya, and N. S. Zolotareva.
Journal of Hydraulic Research JHYRAF, Vol. 29, No. 2, p 149-160, 1991. 4 fig, 23 ref.

Descriptors: *Benthos, *Bottom sediments, *Channel erosion, *Scour, *Sediment erosion, *Sediment

transport, Bacteria, Erosion, Microorganisms, Midges, Oligochaetes, Population density, Protozoa, Sand, Sedimentation, Shear stress, Silt, Suspended sediments, Temperature, Tractive forces, Velocity.

The effect of benthic organisms on the erosion of cohesive sediments was studied in a laboratory flume. The presence of oligochaetes (10,000 individuals/sq m) in silt resulted in 24 mg/L suspended particles even in undisturbed water. Erosion occurred only at a velocity exceeding 0.12 m/s, the population density being 100 individuals or less. Increasing the number of worms led to an evident decrease in the threshold velocity (0.08-0.09 m/s). The influence of chironomids was studied in silty sand and sandy silt in a population density of 3,000 individuals/sq m. With an increasing velocity (up to 0.22 m/s), the concentration of suspended particles in the flux also increased (up to 5.0 g/L) in both types of sediment. On the second and third days, the maximum sediment concentration fell to 1.2-1.4 g/L, and continued to curve downward. Shear stress on the surface of the silty sediments can decrease 10-fold in the presence of burrowing organisms, corresponding to the decrease in critical erosive flow velocity (2-3 times fall). This effect is very dependent on both population density and temperature. The effect of the macrobenthos is considerable in heavily polluted water, where the population density of burrowing organisms is high. Microorganisms on small particles (bacteria and protozoa) also appear to have a great effect on the transportation of suspended sediments due to a decrease in the settling velocity and critical tractive force. (Doria-PTT)
W91-12364

TIME DISTORTION IN LARGE SCALE SEDIMENT MODEL TESTS.
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
Z. Wang, and W. Kron.
Journal of Hydraulic Research JHYRAF, Vol. 29, No. 2, p 161-178, 1991. 16 fig, 7 ref.

Descriptors: *Hydraulic models, *Model studies, *Sediment erosion, *Sediment transport, *Time distortion, Deformation, Flow, Hydrodynamics, Simulation models, Theoretical analysis, Yangtze River.

The problem of time distortion and its effect on the similarity between sediment scale models and their prototypes was studied both theoretically and experimentally. Theoretical analysis indicated that time distortion results mainly in dissimilar erosion in lower sections of large mobile bed sediment models. To test this theory a part of the upper course of the Yangtze River was modeled using a large bed load model; a hydrodynamic model was employed to simulate flow for both a normal and a time-distorted case. Results proved that time distortion in sediment transport model tests can have significant effects on the representativeness of results. However, the impact of time distortion is serious only in the outlet region of the modeled reach. The longer the modeled reach and the larger the coefficient of time distortion, the larger the influenced area and the more serious the deformation of the bed profile. The effect of time distortion can be reduced if countermeasures are taken during the test. One such measure would be to feed water into the model during the rising period of the flood wave and withdraw water from the model during the receding period at several locations along the reach. (Doria-PTT)
W91-12365

TIDAL RESUSPENSION OF SEDIMENTS IN NORTHERN CHESAPEAKE BAY.
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
L. P. Sanford, W. Panageotou, and J. P. Halka.
Marine Geology MAGEA6, Vol. 97, No. 1/2, p 87-103, March 1991. 9 fig, 1 tab, 34 ref, append.

Descriptors: *Chesapeake Bay, *Dredging, *Sediment distribution, *Sediment transport, *Tidal effects, Bays, Erosion, Salinity, Sediments, Stratification, Suspended sediments, Tides.

Tidal resuspension experiments were carried out on two occasions during the winter of 1988-1989 at a disposal site, for hydraulically dredged sediments, in northern Chesapeake Bay to determine the influence of tidal resuspension on erosion of recent deposits. The results indicate that normal tidal erosion depths were only a fraction of a millimeter per half tidal cycle and probably did not account for the majority of the apparent sediment loss. Erosion rate was found to be a linear function of the excess of estimated shear stress over a critical value, but both the constant of proportionality and the critical shear stress were much less than many previously reported results. The most likely explanation for these low values was that the thin layer of surface sediments involved in regular tidal resuspension had only a few hours at most to consolidate between resuspension events. Observed resuspended sediment concentrations (up to 35 mg/L above background levels) were much less than those reported for previous observations of tidal resuspension in the nearby channel, presumably due to greater stratification and lower tidal velocities at the disposal site. Salinity-induced stratification of the water column was estimated to have reduced shear stresses by up to 50% relative to the neutrally stratified case. Regular tidal resuspension of a thin layer of surface sediments was implicated as a potentially important aspect of the typical benthic environment of northern Chesapeake Bay, even if it is not the most important factor in massive sediment erosion and transport. (Author's abstract)
W91-12392

HYDROLOGIC REGRESSION SEDIMENT-YIELD MODEL FOR TWO UNGAGED WATERSHED OUTLET STATIONS IN AFRICA.
Military Technical Coll., Cairo (Egypt).
O. M. Moussa, S. E. Smith, and R. L. Shrestha.
Environmental Geology and Water Sciences EGWSEI, Vol. 17, No. 3, p 177-183, May/June 1991. 8 fig, 1 tab, 16 ref.

Descriptors: *Hydrologic models, *Regression analysis, *Sediment discharge, *Sediment yield, *Suspended sediments, Atbara River, Blue Nile River, Discharge measurement, Error analysis, Flood discharge, Flow discharge, Model studies.

A hydrologic regression sediment-yield model was established to determine the relationship between water discharge and suspended sediment discharge at the Blue Nile and the Atbara River outlet stations during the flood season. The model consisted of two main submodels: (1) a suspended sediment discharge model, which was used to determine suspended sediment discharge for each basin outlet; and (2) a sediment rating model, which related water discharge and suspended sediment discharge for each outlet station. Due to the absence of suspended sediment concentration measurements at or near the outlet stations, a minimum norm solution, which is based on the minimization of the unknowns rather than the residuals, was used to determine the suspended sediment discharges at the stations. In addition, the sediment rating submodel was regressed by using an observation equations procedure. Verification analyses on the model were carried out and the mean percentage errors were found to be (+)12.59 and (-)12.39, respectively, for the Blue Nile and Atbara. The hydrologic regression model was found to be most sensitive to the relative weight matrix, moderately sensitive to the mean water discharge ratio, and slightly sensitive to the concentration variation along the River Nile's course. (Author's abstract)
W91-12462

FLOW IN RIVER CHANNELS: NEW INSIGHTS INTO HYDRAULIC RETENTION.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
For primary bibliographic entry see Field 2E.
W91-12471

SIMILARITY OF WHOLE-SEDIMENT MOLECULAR DIFFUSION COEFFICIENTS IN FRESHWATER SEDIMENTS OF LOW AND HIGH POROSITY.
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2H.
W91-12488

PREDICTIONS OF SURFICIAL SEDIMENT COMPOSITION IN THE LITTORAL ZONE OF LAKES.
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 2H.
W91-12491

TIDE GAUGE RECORDS, WATER LEVEL RISE, AND SUBSIDENCE IN THE NORTHERN GULF OF MEXICO.
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
For primary bibliographic entry see Field 2L.
W91-12497

SEDIMENT ACCUMULATION RATES IN CONOWINGO RESERVOIR AS DETERMINED BY MAN-MADE AND NATURAL RADIONUCLIDES.
Maryland Dept. of Natural Resources, Annapolis. Power Plant and Environmental Review.
R. I. McLean, J. K. Summers, C. R. Olsen, S. L. Domotor, and I. L. Larsen.
Estuaries ESTUDO, Vol. 14, No. 2, p 148-156, June 1991. 6 fig, 2 tab, 19 ref.

Descriptors: *Conowingo Reservoir, *Environmental tracers, *Reservoir sediments, *Sedimentation rates, *Susquehanna River, Accretion, Cesium radioisotopes, Sediment transport, Suspended sediments, Water resources development.

The Susquehanna River is the major contributor to sediment loadings in the Chesapeake Bay. Because many environmental contaminants are associated with suspended particulates, the degree of particle retention within the reservoirs of the lower Susquehanna River is an important consideration in evaluating contaminant loadings to the Chesapeake Bay. Profiles of weapons-test 137-Cs, nuclear power plant related 134-Cs and 137-Cs, and naturally derived 210-Pb were used to estimate rates of sediment accretion in the Conowingo Reservoir, an impoundment of the Susquehanna River along the Maryland-Pennsylvania border. Net accretion rates ranged from about 2 cm/yr downstream of a nuclear powerplant cooling discharge to a high of about 7 cm/yr at the mount of an incoming creek. Slight, but consistent, increases in the annual rate of accretion since the creation of the reservoir in 1982 are apparent. The current net average annual sediment load retained by the reservoir is estimated to be 400,000 to 1,500,000 tons/yr. The retained sediment load represents about 8-23% of the long-time average sediment input to the reservoir. (Author's abstract)
W91-12498

SPECIES-SPECIFIC SEDIMENTATION AND SINKING VELOCITIES OF DIATOMS.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 2L.
W91-12520

SOIL MOVEMENT BY TILLAGE AS AFFECTED BY SLOPE.
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
M. J. Lindstrom, W. W. Nelson, T. E. Schumacher, and G. D. Lemme.
Soil and Tillage Research SOTRD5, Vol. 17, No. 3/4, p 255-264, September 1990. 6 fig, 10 ref.

Descriptors: *Erosion, *Slopes, *Soil erosion, *Tillage, Agricultural practices, Plowing, Ridges.

Exposure of subsoil material on ridge tops and adjacent sideslopes indicates soil movement away from these positions, i.e. soil erosion. A study was conducted to determine if soil movement by tillage could be a contributing factor to the apparent soil

erosion present on many ridge tops. Numbered soil movement detection units (11 mm steel hexagona nuts) were buried 10 cm deep in a grid network in 16 individual plots, on a sideslope with slopes ranging from 1-8%. Plots were moldboard plowed and disked in June, and again in August. The direction of tillage was either across the sideslope or up- and downslope. The soil movement detection units were then located with a metal detector, excavated and identified, and distance moved was measured in relation to movement perpendicular and parallel to the direction of tillage. Soil movement was directly related to slope. Movement perpendicular off the moldboard on a 8% downslope direction was approximately twice the movement upslope. Movement parallel to the direction of tillage was greater than movement perpendicular off the moldboard. Calculations on the angle of movement in relation to tillage direction showed movement toward the downslope position. Results from this study suggest that soil movement by tillage can contribute to soil movement off ridge tops and adjacent sidelopes. (Author's abstract)
W91-12527

WAKE VORTEX SCOUR AT BRIDGE PIERS.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-12563

SEDIMENT TRANSPORT MODEL FOR LAKE KETEL (THE NETHERLANDS): A TOOL FOR WATER MANAGEMENT.
Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
For primary bibliographic entry see Field 5B.
W91-12585

KINEMATIC CHARACTERISTICS OF TRIBUTARIES OF THE VAKHSH RIVER IN THE FLOODING ZONE OF THE ROGUN RESERVOIR.
For primary bibliographic entry see Field 2E.
W91-12611

EFFECTS OF LAND-MANAGEMENT PRACTICES ON SEDIMENT YIELDS IN NORTHEASTERN GUILFORD COUNTY, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 4C.
W91-12660

INFLUENCE OF RESUSPENSION ON SEDIMENT OXYGEN DEMAND (SOD) IN THE LAKES OF DIFFERENT MORPHOLOGY AND TROPHY.
Nicholas Copernicus Univ. of Torun (Poland). Inst. of Biology.
For primary bibliographic entry see Field 5B.
W91-12701

SLUMP INDUCED SURGES AND SEDIMENT TRANSPORT IN LAKE URI, SWITZERLAND.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
C. Siegenthaler, and M. Sturm.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 955-958, March 1991. 3 fig, 6 ref.

Descriptors: *Floods, *Lake Uri, *Sediment transport, *Sedimentation, *Slump, *Surges, *Switzerland, *Turbidity currents, Clays, Deposition, Lake sediments, Reuss Valley, Shearing, Silt, Suspended sediments, Thermocline, Turbidity.

Lake Uri sediments have been studied since the summer of 1988, after a disastrous flood in the Reuss valley, Switzerland, which interrupted the railway and highway connections to Italy. Thirteen piston cores with lengths of up to 1 m have been sampled, and more than 100 km high resolution seismic lines have been executed. The sediments in Lake Uri are dominated by the clastic input of the tributaries to the lake. The average deposition rate during the last 10,000 years is approximately 1 cm/year in the lake basin. Two distinct depositional areas have been distinguished: deltas with coarse clastic layers a few cm to several dm thick, separated by silt and clay layers; and the basin plane, with silt and clay laminae, or turbidities a few cm thick, or several exceptionally large turbidities. From comparisons with assemblages of a slump and a homogenite in other basins of Lake Lucerne, the following events must have happened in the evening of September 23, 1687: (1) on the delta of the Muota, a large mass of more than 10,000,000 cu m became spontaneously unstable, flowed down the slope and spread out in the basin plane for more than 2 km; (2) the impact of the slump motion triggered a surge with a wave height of 5 m; (3) the motion of the slump, involving a folding and shearing of the sediment strata, produced a large suspension cloud with suspended sand, silt and clay, which, unaffected by the thermocline, travelled down the slope as a turbidity current; and (4) a small fraction of the suspension was injected into the water above the thermocline, from where the finest particles were spread over the lake and settled slowly down to form a thin whitish clay cap on top of the homogenite. (Brunone-PTT)
W91-12714

CHEMICAL STUDIES ON SEDIMENTS IN THE RIO DOCE VALLEY LAKES, BRAZIL.
Aichi Univ., Toyohashi (Japan). Faculty of Liberal Arts.
For primary bibliographic entry see Field 2H.
W91-12764

ZOOPLANKTON UNDER STRESS CAUSED BY SEDIMENT RESUSPENSION.
Nicholas Copernicus Univ. of Torun (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W91-12795

SEDIMENTARY FACIES OF HOLOCENE SUBAQUEOUS CHANGJIANG RIVER DELTA (IN CHINESE).
East China Normal Univ., Shanghai.
Z. Chen, S. Xu, and Q. Yan.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 22, No. 1, p 29-37, January 1991. 6 fig, 1 tab, 2 ref. English summary.

Descriptors: *China, *Deltas, *Estuarine environment, *Paleohydrology, *Sedimentary structures, *Stratigraphy, Aquatic animals, Estuaries, Estuarine sediments, Holocene Epoch, Organic matter, Pliocene Epoch, Runoff, Salinity, Sedimentary petrology, Stratification, Tectonics, Tidal currents, Turbidity.

Changjiang delta (China) is one of the largest deltas in the world, with a total area of about 51,800 sq km, yearly runoff of 995 billion cu m and yearly fluvial input of 0.486 billion cu m. The Holocene delta has been reconstructed using the background of tectonic subsidence since Pliocene. Its strata, according to the analysis of sedimentary texture, structure, pollen and spores, microfauna and radiocarbon, can be classified into three sections, namely the lower, middle and upper, each corresponding to the early, middle and late stage deposition of the Holocene period. From the river mouth to the sea, there exist three sedimentary facies representing the delta front, the prodelta and the delta-shelf transitional zone. At water depth of 12 m is the average normal wave base that is the boundary between the delta front and prodelta. The greyish yellow silty fine sand with a high content (0.5-2.0%) of heavy minerals is the dominant terrigenous material in the delta front carried by runoff. Owing to the lower salinity and higher turbidity in the estuary, the species and numbers of microfauna are scarce in the sediment except those transported from open sea by tidal currents. The sediments in the prodelta are much finer, mostly composed of darkish grey silty clay a with higher organic content (1.0-1.5%) and much microfauna. With increasing water depth, the sediment gradually changed into clayey sand, the coarser sand being obviously deposited in the period of standstill of post-glaciation transgression, reflecting the transition from prodelta to the shelf. The facies sequences of the subaqueous delta from top downward are delta front and prodelta. The facies index of the sequence is quite similar to delta front, prodelta and the delta-shelf transitional zone. In addition to much burrowing in the prodelta, various kinds of cross beddings appeared in the delta front and sinuous, horizontal lamina. (Author's abstract)
W91-12835

PRELIMINARY STUDIES ON SEDIMENTATION RATE AND SEDIMENT FLUX OF THE SOUTH HYANGHAI SEA (IN CHINESE).
Academia Sinica, Qingdao (China). Inst. of Oceanology.
Y. Zhao, F. Li, D. J. DeMaster, C. A. Nittrouer, and J. D. Milliman.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 22, No. 1, p 39-43, January 1991. 3 fig, 2 tab, 6 ref. English summary.

Descriptors: *China, *Huanghai Sea, *Ocean circulation, *Sediment transport, *Sedimentation, *Sedimentation rates, Fluctuations, Sand, Sediment distribution, Temperature effects, Water currents.

The sedimentation rate and flux of the South Huanghai Sea, China was examined. The large depocenter of the region lies on the south side of Shandong Peninsula. Sedimentation rates ranged from 0.026-0.67 cm/yr and flux variation was 0.033-0.76 sq cm/a. In the area near the Chengshan Cape hydrodynamic conditions were unusually active and sedimentation flux was extremely low. It appeared that the relict sand lies on the east side. Sedimentation was low in the area where the Huanghai Sea warm current passed through and cold eddies were present. Mud in the cold eddy area may be relict mud, but on the basis of 210Pb profile analysis, it can be inferred that sedimentation was occurring in the area, although the sedimentation flux was not high within the past 100 yr. Sedimentation in other places in the study areas was moderate. The main factors controlling the sedimentation rate and flux were material sources and sea current systems. (Mertz-PTT)
W91-12836

DANUBE DELTA GENESIS, EVOLUTION AND SEDIMENTOLOGY.
Institute of Geology and Geophysics, Bucharest (Romania).
N. Panin.
Revue Roumaine de Geologie Geophysique et Geographie: Geographie, Vol. 33, p 25-36, 1989. 4 fig, 38 ref.

Descriptors: *Danube Delta, *Deltas, *Geologic history, *Sedimentation, *Sedimentology, *Stratigraphy, Fluvial sediments, Lake sediments, Littoral drift, Loess, Marine sediments.

The Danube Delta can be divided into three major depositional systems: the delta plain, which includes the marine delta plain area; the delta front, divided into delta-front platform and delta-front slope which extends off-shore to a water depth of 30-40 m; and the prodelta, which lies off-shore, at the base of the delta-front down to a depth of 50-60 m. The Danube Delta edifice is formed from a sequence of detrital deposits of tens to 300-400 m thick. These deposits were formed mainly during the Upper Pleistocene and the Holocene. The Holocene evolution of the Danube Delta displays several main phases: (1) the formation of the initial Letea-Caraorman spit, 11,700-7500 years B.P;. (2) the Sfintu Gheorghe I Delta, 9000-7200 years B.P.; (3) the Sulina Delta, 7200-200 years B.P.; (4) the Sfintu Gheorghe II Delta and the Chilia Delta, 2000 years B.P.–present; and (5) the Cosna-Sinoie Delta, 3500-1500 B.P. The Danube delta displays a few main facies types of sediments: (1) two types of marine littoral deposits, one type formed by littoral drift from the North and another of Danubian origin; (2) lacustrine littoral deposits; (3) fluvi-

al deposits, genetically related to the Danube distributaries systems; (4) marsh deposits; and (5) loess-like deposits. (Mertz-PTT)
W91-12843

SOME PROBLEMS CONCERNING THE GENESIS, CLASSIFICATION AND USE OF SOILS IN THE DANUBE DELTA.
Kumm Industries, Inc., Phoenix, AZ.
For primary bibliographic entry see Field 2E.
W91-12845

DYNAMICS OF THE WLOCLAWEK RESERVOIR BANKS.
Nicholas Copernicus Univ. of Torun (Poland). Inst. of Geography.
M. Banach.
Revue Roumaine de Geologie Geophysique et Geographie: Geographie, Vol. 33, p 67-73, 1989. 3 fig, 1 tab, 4 ref.

Descriptors: *Bank erosion, *Dam effects, *Landslides, *Slope stability, *Woclawek Reservoir, Nearshore processes, Stream banks, Vistula River, Water level fluctuations, Wave action.

The mean annual discharge in the Vistula River at Wloclawek was approximately 950 cubic m/second for a multi-year period. Water level fluctuations reached 6 m, water table slope was 0.2% and flow velocity ranged from 0.8-1.0 m/second at medium stages. After a dam was constructed across the river, flow velocity decreased gradually, whereas the river depth and width increased. Repeated measurements were undertaken in 43 cross-sections of the bank. Depth surveys were conducted at a near-bank terrace along selected bank sections that differed in morphology, geology and hydrodynamics. Attempts were made to map the bank. Fifty-four sections of the right-bank slope, produced over the 1971-1973 period, were used for landslide dynamics study. The construction of the dam across the river initiated changes in bank processes. Erosion by the Vistula was replaced with abrasion by wind-generated wave motion on enlarged water surfaces. This factor was especially important in the first few years. Ultimately, the dynamic equilibrium of high banks became disturbed. The effects included intense bank scour by waves, enhanced activity of the existing landslide areas, formation of new landslide areas, and entry of landslides into the Morainie plateau. Since the late 1970s, the intensity of geodynamic processes had declined due to the formation of a new slope base. The zones of supply (bank erosion), transit and accumulation of deposits carried along as a sheet eventually became fully developed. The parameters of near-bank platforms changed slightly but the platforms were wide enough to be entered by sediments carried along the banks in the stream. This last stage of development did not result in total inhibition of bank modification, but in a fall in its rate. (Mertz-PTT)
W91-12846

RUNOFF AND EROSION FOLLOWING MECHANICAL AND CHEMICAL CONTROL OF CREOSOTEBUSH (LARREA TRIDENTATA).
New Mexico State Univ., Las Cruces. Dept. of Animal and Range Sciences.
For primary bibliographic entry see Field 4A.
W91-12885

RIVER ALLUVIUM AND THE BEACH FORMATION OF THE NORTH-EAST CAUCASIAN BLACK SEA COAST (IN RUSSIAN).
Kubanskii Gosudarstvennyi Univ., Krasnodar (USSR).
N. I. Kochetov.
Okeanologiia OKNOAR, Vol. 31, No. 2, p 296-300, 1991. 2 tab, 8 ref. English summary.

Descriptors: *Alluvium, *Beaches, *Black Sea, *Sediment transport, Annual distribution, Beach formation, Coastal zone, Sedimentation, USSR.

The coastal zone of a region along the North-East coast of the Caucasian Black Sea, has 6477.6 ths/cu m of river beach forming alluvium, which creates > 0.2 mm of beach/yr. Total sediment formation varies from 0.33 to 3.76 cu m/yr/linear meter of coast, averaging 2.16 cu m/yr. Anthropogenic beach formation is making it possible for coastal zones to be protected. (Author's abstract)
W91-12897

2K. Chemical Processes

ALKALINE, SALINE LAKES OF UGANDA: A REVIEW.
Uganda Freshwater Fisheries Research Organization, Jinja.
For primary bibliographic entry see Field 2H.
W91-11628

EQUILIBRIUM SPECIATION MODELS FOR HG, CD, AND PB IN THE GULF OF BOTHNIA AND ITS CATCHMENT AREA.
Umea Univ. (Sweden). Dept. of Inorganic Chemistry.
For primary bibliographic entry see Field 5B.
W91-11661

PHOSPHATASES REVISITED: ANALYSIS OF PARTICLE-ASSOCIATED ENZYME ACTIVITIES IN AQUATIC SYSTEMS.
Kinneret Limnological Lab., Tiberias (Israel).
T. Berman, D. Wynne, and B. Kaplan.
Hydrobiologia HYDRB8, Vol. 207, p 287-294, November 22, 1990. 2 fig, 4 tab, 20 ref. Israel National Council for Research and Development No. WF12.

Descriptors: *Bioassay, *Bioindicators, *Enzymes, *Phosphatases, *Separation techniques, Aquatic habitats, Body size, Orthophosphates, Plankton, Size fractions.

A modified assay for alkaline or acid phosphatases associated with microorganisms in aquatic environments has been developed. The method consists of collecting microplankton on filters and subsequently determining the enzyme activities spectrophotometrically or fluorometrically, using p-nitrophenyl-phosphate or 4-methylumbelliferyl phosphate, respectively as substrates. The assay is simple and rapid, and has the further advantage of permitting phosphatase activities to be assigned to specific size fractions of the natural microplankton. In samples taken from Lake Kinneret and a nearby reservoir, a consistently high proportion of the total alkaline or acid phosphatase activity was associated with the size fraction <0.8 microm and >02 microm, indicating the potentially high contribution of bacteria to these activities. This approach can also be used to examine the enzymatic potential of microzooplankton for releasing orthophosphate from other organo-phosphate substrates. (Author's abstract)
W91-11714

SOME REMARKS ON THE PRESENCE OF ORGANIC PHOSPHATES IN SEDIMENTS.
Station Biologique de la Tour du Valat, Arles (France).
C. J. De Groot.
Hydrobiologia HYDRB8, Vol. 207, p 303-309, November 22, 1990. 1 fig, 4 tab, 21 ref.

Descriptors: *Garonne River, *Phosphates, *Po River, *Rhone River, *Sediment analysis, *Sediment chemistry, *Water analysis, Estimating, Hydrogen ion concentration, Hydrolysis, Phosphorus cycle, Separation techniques.

A new method has been developed to assess the size and nature of the organic phosphate pool. Using sediment suspensions from the Rhone, Garonne, and Po rivers, inorganic phosphorus compounds Fe(OOH) and CaCO3 were removed using mild extractants at sediment pH. The residual phosphate was then fractionated into an acid-soluble organic phosphate pool and a residual phosphate pool by acid hydrolysis (0.5 M H(1+)). Both pools were quantitatively important, accounting for between 16 and 54% and 16 and 51% of total phosphate, respectively. Acid hydrolysis was chosen, since a distinct plateau, with high reproducibility, resulted within 30 minutes. This fractionation permits a further study of dynamics and bioavailability of sediment organic phosphorus, without interferences of Fe(OOH) and CaCO3. In many studies in which changes in the organic pool were examined after extraction of inorganic phosphate, 0.5 M HCl was used to extract apatite bound phosphate, which is likely to result in a considerable underestimation of the organic phosphate pool. (Author's abstract)
W91-11716

MIXED WEAK ACID/BASE SYSTEMS, PART II: DOSING ESTIMATION, AQUEOUS PHASE.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-11766

PESTICIDES.
Lafayette Coll., Easton, PA. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-11775

ENVIRONMENTAL ANALYSIS.
Ontario Ministry of the Environment, Rexdale. Lab. Services Branch.
For primary bibliographic entry see Field 5A.
W91-11776

WATER ANALYSIS.
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
P. MacCarthy, R. W. Klusman, S. W. Cowling, and J. A. Rice.
Analytical Chemistry ANCHAM, Vol. 63, No. 12, p 301R-342R, June 15, 1991. 1 tab, 1356 ref.

Descriptors: *Chemical analysis, *Literature review, *Pollutant identification, *Water analysis, Data acquisition, Groundwater quality, Soil water, Surface water, Water quality.

This is the 24th biennial literature review article dealing with the inorganic and organic analytical chemistry of water. Some trends became evident in the preparation of this review compared to the previous review of 2 years ago. Because of the increased number of abstracts dealing with hydrocarbon analysis and organometallic compounds, each of these classes was given its own section in the current review. Another obvious trend is the increased interest in enzyme-based methods and in techniques using fiber optic sensors. Despite any desire to the contrary, an extensive review such as this is based exclusively on an examination of the abstracts of the papers as published in 'Chemical Abstracts'; the original articles were not consulted. The title of this article refers to the analysis of constituents in water, dissolved or otherwise, and to other analytical parameters that describe a water sample, such as pH or alkalinity. Most of the papers reviewed deal with methods for quantitative determination, and deals primarily with natural waters such as groundwaters, river waters, lake waters, seawater, rain water, and soil waters. (Lantz-PTT)
W91-11777

RECONNAISSANCE OF THE OCCURRENCE OF AGRICULTURAL CHEMICALS IN GROUND WATER IN HAYWOOD, LAKE AND OBION, AND SHELBY COUNTIES, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11866

AQUIFER-CHARACTERISTICS AND WATER-CHEMISTRY DATA FROM WELLS ON OR NEAR NAVAJO TRIBAL LANDS IN THE ZUNI RIVER BASIN AND WHITEWATER ARROYO DRAINAGE, WEST-CENTRAL NEW MEXICO.
Geological Survey, Albuquerque, NM. Water Re-

sources Div.
For primary bibliographic entry see Field 2F.
W91-11870

EXTENSION OF USEPA METHOD 531 FOR THE ANALYSIS OF SEVERAL CLASSES OF NITROGENOUS PESTICIDES IN GROUNDWATER BY POSTCOLUMN UV PHOTOLYSIS.
Florida Univ., Gainesville. Pesticide Research Lab.
For primary bibliographic entry see Field 5A.
W91-11873

REGENERATION PROPERTIES OF SPENT TAILORED SOILS.
New Mexico State Univ., Las Cruces. Dept. of Civil, Agricultural and Geological Engineering.
For primary bibliographic entry see Field 5G.
W91-11875

NEW APPROACHES TO METAL SPECIATION IN NATURAL WATERS BASED ON MODIFIED AND MICROVOLTAMMETRIC ELECTRODES.
New Mexico State Univ., Las Cruces. Dept. of Chemistry
For primary bibliographic entry see Field 5A.
W91-11876

MOLECULAR STRUCTURE BASIS FOR THE MUTAGENICITY OF LIGNIN- AND HUMIC-DERIVED CHLOROFURANONES.
State Univ. of New York, Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 5D.
W91-11878

EFFECTS OF SITE DISTURBANCE ON THE MOBILIZATION AND DISTRIBUTION OF NUTRIENTS AND TRACE METALS IN FOREST SOILS.
Maine Univ. at Orono. Dept. of Plant, Soil and Environmental Sciences.
For primary bibliographic entry see Field 2G.
W91-11880

PALEOCLIMATIC HISTORY OF DEVILS LAKE, NORTH DAKOTA: FINAL REPORT.
Mackay School of Mines, Reno, NV.
For primary bibliographic entry see Field 2H.
W91-11910

QUALITY OF WATER FROM SURFICIAL-OUTWASH AQUIFERS IN THE BIG SIOUX RIVER BASIN, EASTERN SOUTH DAKOTA.
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11918

BACKGROUND CONCENTRATIONS OF SELECTED RADIONUCLIDES, ORGANIC COMPOUNDS, AND CHEMICAL CONSTITUENTS IN GROUND WATER IN THE VICINITY OF THE IDAHO NATIONAL ENGINEERING LABORATORY.
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11924

CHEMICALS AND ISOTOPIC DATA FOR WATER FROM WELLS, SPRINGS, AND STREAMS IN CARBONATE-ROCK TERRAIN OF SOUTHERN AND EASTERN NEVADA, 1985-88.
Geological Survey, Charleston, WV. Water Resources Div.
J. M. Thomas, B. F. Lyles, and L. A. Carpenter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 89-422, 1991. 24p, 1 tab, 1 pl, 5 ref.

Descriptors: *Nevada, *Radioisotopes, *Stable isotopes, *Water chemistry, Carbon isotopes, Deuterium, Groundwater quality, Tritium, Water quality.

Chemical and isotopic data for water collected from wells, springs, and streams in southern and eastern Nevada and southeastern California in 1985-88 as part of the Nevada Carbonate Aquifers Program include temperature, specific conductance, pH, dissolved oxygen, dissolved organic carbon, major ions, trace constituents, stable isotopes, and radioactive isotopes. A total of 247 samples were collected at 209 sites. Methods used in sample collection are described and the laboratories used to analyze the samples are identified. (USGS)
W91-11939

WATER QUALITY OF FOUNTAIN AND MONUMENT CREEKS, SOUTH-CENTRAL COLORADO, WITH EMPHASIS ON RELATION OF WATER QUALITY TO STREAM CLASSIFICATIONS.
Geological Survey, Pueblo, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11948

PHYSICAL FACTORS INFLUENCING WINTER PRECIPITATION CHEMISTRY.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Atmospheric Physics Lab.
For primary bibliographic entry see Field 2B.
W91-11968

LOW-INTENSITY RADIOLYSIS STUDY OF FREE-RADICAL REACTIONS IN CLOUDWATER: H2O2 PRODUCTION AND DESTRUCTION.
Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
For primary bibliographic entry see Field 2B.
W91-11969

URBAN PRECIPITATION CHEMISTRY: A REVIEW AND SYNTHESIS.
Illinois State Water Survey Div., Champaign. Atmospheric Chemistry Section.
D. F. Gatz.
Atmospheric Environment Part B: Urban Atmosphere AEBAE5, Vol. 25, No. 1, p 1-15, 1991. 11 fig, 3 tab, 49 ref. Preservation Assistance Division of the National Park Service Cooperative Agreement INT CA 042468002.

Descriptors: *Chemistry of precipitation, *Precipitation sampling, *Reviews, *Urban areas, *Urban hydrology, Calcium, Chlorides, Dry deposition, Hydrogen ion concentration, Magnesium, Nitrates, Research priorities, Sodium, Sulfates.

Urban sampling sites have been specifically excluded from recent large networks for measuring chemical composition of precipitation. Because information on precipitation composition in urban areas is needed for a variety of current applications, it is useful to summarize present knowledge. Most of the available information is based on samples of bulk precipitation, collected by continuously open collectors. This method is now widely acknowledged to be of limited value because of its poor sampling characteristics for dry deposition. For many ions, particularly those residing on large airborne particles, urban bulk sampling yielded considerably higher concentrations than found in samples collected in 'wet-only' samplers. Spatial variability of ionic concentrations in urban areas is expressed in terms of the sample standard deviation of site precipitation-weighted means, as a percentage of the overall urban mean. Median values of the most major ions were near 30%; half of the available measurements were between 20 and 47%. Differences between urban and nearby rural concentrations of ions in precipitation were often reported. Those ions with some tendency to occur in higher concentrations in cities included Na(+), Mg(2+), Ca(2+), NO3(-), SO4(2-), and Cl(-). These differences should be viewed with caution, however, because they were usually based on one or two, possibly unrepresentative, rural sampling sites. Seasonal variations of urban H(+) concentrations were different in Europe and the U.S. Highest concentrations occurred in winter in Europe, but in summer in the U.S. There is a pressing need for additional urban precipitation chemistry monitoring and research. (Author's abstract)
W91-11987

STEM-II ACID DEPOSITION AND PHOTOCHEMICAL OXIDANT MODEL: II. A DIAGNOSTIC ANALYSIS OF MESOSCALE ACID DEPOSITION.
Iowa Univ., Iowa City. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5B.
W91-11988

CHARACTERIZATION OF EXOPOLYMERS OF AQUATIC BACTERIA BY PYROLYSIS-MASS SPECTROMETRY.
Harvard Univ., Cambridge, MA. Lab. of Microbial Ecology.
T. Ford, E. Sacco, T. Kelley, R. Goodacre, and R. C. W. Berkeley.
Applied and Environmental Microbiology AEMIDF, Vol. 57, No. 6, p 1595-1601, June 1991. 4 fig, 2 tab, 45 ref. Naval Research Grant No. N00014-88-K-0121 and Cooperative Agreement No. NCC8-17 between Harvard University and NASA Marshall Space Flight Center.

Descriptors: *Aquatic bacteria, *Exopolymers, *Laboratory methods, *Mass spectrometry, *Pyrolysis, Bacterial analysis, Chemical analysis, Classification, Polymers.

Exopolymers from a diverse collection of marine and freshwater bacteria were characterized by pyrolysis-mass spectrometry (Py-MS). Py-MS provides spectra of pyrolysis fragments that are characteristics of the original material. This chemical analysis of the bacterial exopolymers shows gross differences in composition for some components. However, these methods are too insensitive to provide quantitative data, with considerable variation in percent exopolymer composition being accounted for by the components evaluated. The mass spectra provide signatures for specific polymers that reflect their chemical composition. Mass fragments can be attributed to various precursors, keeping in mind that patterns of precursors are not unambiguous since spectra can be derived from more than one source. Patterns of precursors that are of interest when examining bacterial exopolymers are carbohydrates, proteins, and aliphatic hydrocarbons. Specific markers for functional groups are also of interest. Py-MS should prove a useful characterization tool for bacterial exopolymers, providing an extremely specific and reproducible fingerprint. In this study, qualitative differences in exopolymers have been detected that were not detectable by proton magnetic resonance spectroscopy. Isolation of small quantities of this material is relatively straightforward, allowing Py-MS to be used to characterize unknown bacteria by their exopolymers. (Lantz-PTT)
W91-12010

RADIONUCLIDES IN THE ENVIRONMENT.
Section of Energy, Div. of Water and Pollution Prevention, Dept. of Environment, 14, Boulevard du General Leclerc, 92524 Neuilly-sur-Seine Cedex, France.
For primary bibliographic entry see Field 5B.
W91-12035

ANAEROBIC MICROBIAL BIOGEOCHEMISTRY IN SEDIMENTS FROM TWO BASINS IN THE GULF OF MAINE: EVIDENCE FOR IRON AND MANGANESE REDUCTION.
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
M. E. Hines, D. A. Bazylinski, J. B. Tugel, and W. B. Lyons.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No.4, p 313-324, April 1991. 4 fig, 46 ref.

Descriptors: *Anaerobic conditions, *Biogeochemistry, *Chemical reduction, *Denitrification, *Diagenesis, *Geochemistry, *Gulf of Maine, *Iron, *Manganese, *Sediment chemistry, Continental shelf, Glucose, Interstitial water, Sediments, Sulfates, Sulfides, Sulfur cycle.

Rates of sulfate reduction, denitrification, and glucose turnover were determined in surface sediments collected from Jeffreys and Wilkinson Basins in the Gulf of Maine. These data were compared to porewater profiles of iron and manganese. Three distinct anaerobic biogeochemical situations were evident: (1) sulfate reduction was dominant and active near the sediment-water interface (deeper portions of Jeffreys Basin); (2) denitrification was active in the upper few centimeters and was underlain by rapid sulfate reduction (slope of Jeffreys Basin); (3) denitrification was dominant (Wilkinson Basin). An apparent iron and manganese reduction was evident in all cores. Since glucose turnover was active and both denitrification and sulfate reduction were low within this metal reduction zone, it is possible that microbial metal reduction is a significant process within the basin sediments. High concentrations of dissolved iron occurred within sediments deeper than those supporting active sulfate reduction. Sufficient iron was remobilized during iron reduction not only to precipitate all of the sulfide generated during sulfate reduction but also to allow for dissolved iron to diffuse into deeper sediments. Therefore, large vertical regions containing dissolved iron are not necessarily regions of iron reduction, and iron reduction is restricted to a narrow sediment layer. (Author's abstract)
W91-12043

CARBON ISOTOPE GEOCHEMISTRY OF THE CHANGJIANG ESTUARY.
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
F. C. Tan, D. L. Cai, and J. M. Edmond.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No.4, p 395-403, April 1991. 7 fig, 2 tab, 12 ref.

Descriptors: *Carbon radioisotopes, *Changjiang Estuary, *Geochemistry, *Mass transfer, China, Marine environment, Mixing, Organic carbon, Particulate matter, Productivity, Stream discharge.

An understanding of the discharge of material to the marine environment from rivers is of fundamental importance in the construction of oceanic mass balance, since river discharge is a dominant source of material in the oceans. Stable carbon isotope ratios were used to study the sources and transport of particulate organic carbon (POC) in the Changjiang estuary and the East China Sea. POC samples were collected on two cruises, in the summer (June 1980) and winter (November 1981) seasons of high and relatively low discharge and biological productivity, respectively. Delta C13 values of POC collected in June showed a range of -25.4 to -19.7 ppt, suggesting mixing of riverine and marine organic carbon. Samples collected during November had a delta C13 range of -26.6 to -23.7 ppt, indicative of dominant terrestrial organic carbon contribution. The sedimentary organic carbon in the East China Sea exhibits a relatively narrow delta C13 range (-22.9 to -20.8 ppt), suggesting a dominant marine source. (Doria-PTT)
W91-12047

CHARACTERISTICS OF THE CHEMICAL COMPOSITION OF WATER IN LAKES OF NORTH POLAND (CHARAKTERYSTYKA CHEMICZNEGO SKLADU WODY W JEZIORACH POLNOCNEJ POLSKI).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 5B.
W91-12061

SELENIUM CYCLING THROUGH AGRICULTURAL GRASSLANDS IN THE UK: BUDGETING THE ROLE OF THE ATMOSPHERE.
Lancaster Univ. (England). Dept. of Environmental Sciences.
P. M. Haygarth, K. C. Jones, and A. F. Harrison.
Science of the Total Environment STENDL, Vol. 103, No. 1, p 89-111, April 1991. 2 fig, 11 tab, 67 ref.

Descriptors: *Cycling nutrients, *Deposition, *England, *Grasslands, *Nutrients, *Selenium, *Volatilization, Atmospheric chemistry, Model studies, Particulate matter, Pastures, Plants.

Two idealized Se budget scenarios have been generated to assess the role of atmospheric cycling on the Se status of United Kingdom agricultural grasslands. Based on a thorough literature review, the budgets demonstrate that varying the factors for losses by volatilization from plants and soils or inputs by deposition may significantly affect the net balance of a grassland. The contribution of wet, dry, vapor and particulate deposition inputs to the soil-herbage system are thought to be dominated by a soluble form in wet deposition. The total input is calculated to be typically in the range 0.2-0.7 mg/sq m/yr. Volatile losses from the soil are difficult to derive accurately, but are estimated to range between 0.1 and 10 mg/sq m/yr. The budget suggests there is a net input of Se to herbage from the atmosphere, even in remote/rural locations, where inputs are generally low. Currently in the United Kingdom, because of the contribution of anthropogenic inputs of Se to the air (i.e. fossil fuel consumption and various industrial activities), there is probably an average net input of Se from the air. Inputs of Se to British grasslands appear to be primarily in soluble forms in wet deposition. These may be most available for plant root uptake, and for uptake and biotransformation by soil microorganisms. Soil physicochemical properties strongly influence the cycling, leaching and uptake of atmospherically-derived Se. More research is required to assess more accurately the atmospheric contribution of Se to crops and livestock in agricultural systems. (Geiger-PTT)
W91-12072

CHEMISTRY AND CRUSTACEAN ZOOPLANKTON OF THE SEEWINKEL PANS: A REVIEW OF RECENT CONDITIONS.
Burgenlaendisches Landesmuseum, Eisenstadt (Austria).
For primary bibliographic entry see Field 2H.
W91-12100

GROUND WATER FLOW PATHS IN RELATION TO NITROGEN CHEMISTRY IN THE NEAR-STREAM ZONE.
York Univ., Toronto (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2F.
W91-12124

SPATIAL VARIATION IN BASIC CHEMISTRY OF STREAMS DRAINING A VOLCANIC LANDSCAPE ON COSTA RICA'S CARIBBEAN SLOPE.
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
For primary bibliographic entry see Field 2E.
W91-12126

RADIOGENIC ELEMENTS IN FINNISH SOILS AND GROUNDWATERS.
Geologian Tutkimuskeskus, Espoo (Finland).
P. Lahermo, and R. Juntunen.
Applied Geochemistry APPGEY, Vol. 6, No. 2, p 169-183, 1991. 12 fig, 30 ref.

Descriptors: *Finland, *Geochemistry, *Path of pollutants, *Radioisotopes, *Radon radioisotopes, *Uranium radioisotopes, *Water pollution sources, Bedrock, Distribution patterns, Fluvial sediments, Granites, Groundwater analysis, Public health, Sediment analysis, Soil analysis, Thorium radioisotopes.

In Finland, U and Rn concentrations in groundwaters are highest in the southern part of the country, in bedrock composed of granites or migmatites with abundant granite or pegmatite veins. The areal distribution patterns of U and Rn in groundwater from bedrock are consistent with U and Th anomalies in the fine fraction of till, and with the external gamma dose rate measured on the ground surface. The U and Rn concentrations in groundwater from bedrock were found to be only moderately correlated; hence the elevated U contents do not imply abundant Rn contents. Both elements are practically independent of other dissolved components, with the exception of a moderate correlation between U and bicarbonate (HCO_3) which suggests the occurrence of U-rich carbonates as fracture-coating minerals. In those few areas where there are U and Rn anomalies, exceptionally high Rn concentrations in ambient house air pose a considerable health risk, particularly in detached houses built on pervious sand and gravel deposits. However, regardless of the potential health risk, no radiological recommendations for U and Rn concentrations in potable water have been officially set in Finland. (Author's abstract)
W91-12131

TEMPORAL VARIATIONS IN THE TRACE ELEMENT CONTENT OF STREAM SEDIMENTS: AN EXAMPLE FROM A TROPICAL RAIN FOREST REGIME, SOLOMON ISLANDS.
British Geological Survey, Keyworth (England).
J. Ridgway, and C. Midobatu.
Applied Geochemistry APPGEY, Vol. 6, No. 2, p 185-193, 1991. 4 fig, 5 tab, 9 ref.

Descriptors: *Alluvial sediments, *Environmental chemistry, *Geochemistry, *Rain forests, *Sediment chemistry, *Solomon Islands, *Trace elements, Chemical analysis, Heavy metals, Iron, Sediment analysis, Temporal variation, Tropical regions.

A stream sediment geochemical anomaly in a tropical rain forest environment on Guadalcanal Island, Solomon Islands, was monitored at monthly intervals over a period of 15 months. Major changes in stream sediment chemistry took place after heavy rainfall associated with the passage of the tail of a cyclone through the region. These changes were directly linked to changes in the mineralogical composition of the sediments. Significant chemical variations also occurred in the period before the cyclone but these appear to have been related to variations in hydromorphic dispersion processes. Results show that statistically significant temporal variations in the trace element content of the stream sediments occurred at every sample site monitored. These variations were generally strongest at the three most upstream sites, which were the ones closest to mineralization. The data suggest that common exploration practices, such as the use of 'threshold values', should be applied with caution in tropical rain forest terrain. The use of element/iron ratios in exploration work and smoothing techniques in regional geochemical mapping may help eliminate some of the more pronounced effects of temporal variations in the trace element contents of stream sediments. (Ver-Nooy-PTT)
W91-12132

EARLY DIAGENESIS OF SULFUR IN THE SEDIMENTS OF LAKES THAT RECEIVE ACID MINE DRAINAGE.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W91-12134

QUALITY OF GROUNDWATER IN BAHRAIN.
Environmental Protection Committee, P.O. Box 26909, Bahrain.
For primary bibliographic entry see Field 2F.
W91-12152

CONTINUOUS AUTOMATED SAMPLING OF TIDAL EXCHANGES OF NUTRIENTS BY BRACKISH MARSHES.
Smithsonian Environmental Research Center, Edgewater, MD.
For primary bibliographic entry see Field 2L.

W91-12167

GLACIAL ICE COMPOSITION: A POTENTIAL LONG-TERM RECORD OF THE CHEMISTRY OF ATMOSPHERIC DEPOSITION, WIND RIVER RANGE, WYOMING.
Geological Survey, Cheyenne, WY.
For primary bibliographic entry see Field 2C.
W91-12237

SO2 OXIDATION IN A RAINBAND: EFFECTS OF IN-CLOUD H2O2 PRODUCTION.
McGill Univ., Montreal (Quebec). Dept. of Meteorology.
For primary bibliographic entry see Field 5B.
W91-12252

CHEMICAL LIMNOLOGY OF A HYPERTROPHIC GRAVEL-PIT LAKE.
Centro de Investigaciones del Agua, Madrid (Spain).
For primary bibliographic entry see Field 2H.
W91-12269

BEAVER POPULATION FLUCTUATIONS AND TROPOSPHERIC METHANE EMISSIONS IN BOREAL WETLANDS.
Washington Univ., Seattle. Center for Streamside Studies.
For primary bibliographic entry see Field 2H.
W91-12274

CHEMICAL CHARACTER AND ORIGIN OF ORGANIC ACIDS IN STREAMS AND SEEPAGE LAKES OF CENTRAL MAINE.
Illinois Univ., Urbana. Dept. of Forestry.
For primary bibliographic entry see Field 2H.
W91-12275

PRECIPITATION CHEMISTRY IN AND IONIC LOADING TO AN ALPINE BASIN, SIERRA NEVADA.
California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
For primary bibliographic entry see Field 2B.
W91-12332

SOLUTE CHEMISTRY OF SNOWMELT AND RUNOFF IN AN ALPINE BASIN, SIERRA NEVADA.
California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
For primary bibliographic entry see Field 5B.
W91-12333

PHYSICO-CHEMICAL DISTURBANCES ASSOCIATED WITH SPATIAL AND TEMPORAL VARIATION IN A MEDITERRANEAN RIVER.
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2E.
W91-12395

PLUTONIUM IN SEDIMENTS--APPARENT HALF-LIVES.
Stockholm Univ. (Sweden). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W91-12464

EVALUATION OF CHROMATOGRAPHIC AND SPECTROSCOPIC METHODS FOR THE ANALYSIS OF PETROLEUM-DERIVED COMPOUNDS IN THE ENVIRONMENT.
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
For primary bibliographic entry see Field 5A.
W91-12474

APPLICATION OF THE HIGH-RESOLUTION LOW TEMPERATURE SPECTROFLUOROMETRY TO ANALYSIS OF PAHS IN LAKE SEDIMENTS, MARINE INTERTIDAL SEDIMENTS AND ORGANISMS.
Universite de Savoie, Chambery (France). Lab. de Chimie et Ingenierie de l'Environnement.
For primary bibliographic entry see Field 5A.
W91-12475

SHPOL'SKII FLUORIMETRIC DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN COMPLEX ENVIRONMENTAL SAMPLES.
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W91-12476

DUAL-COLUMN HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC CLEANUP PROCEDURE FOR THE DETERMINATION OF POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS IN FISH TISSUE.
Ontario Ministry of the Environment, Rexdale. Lab. Services Branch.
For primary bibliographic entry see Field 5A.
W91-12481

DISSOLVED OXYGEN CONCENTRATIONS IN HYPERSALINE WATERS.
Warrnambool Inst. of Advanced Education (Australia). Faculty of Applied Science and Technology.
For primary bibliographic entry see Field 2L.
W91-12482

BIOLOGICAL AVAILABILITY OF DISSOLVED ORGANIC CARBON ALONG THE OGEECHEE RIVER.
Georgia Univ., Athens. Inst. of Ecology.
L. G. Leff, and J. L. Meyer.
Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 315-323, March 1991. 5 fig, 1 tab, 17 ref. NSF Grant BSR 87-05744.

Descriptors: *Bioavailability, *Dissolved organic carbon, *Georgia, *Nutrients, *Ogeechee River, *Stream chemistry, Aquatic bacteria, Bacterial growth, Color, Flow discharge, Humic substances.

Quality of dissolved organic C (DOC) from mainstem and tributary sites along the Ogeechee River (Georgia) was compared to that of chemically defined organic C substrates in terms of biological availability. Availability was determined by measuring bacterial growth on natural river water (collected at high and low discharges) and defined organic substrates (humic standards and high-quality sources of C). Availability of DOC to the natural (native) stream bacterial assemblage was compared to that of a defined bacterial inoculum, selected for ability to readily utilize high-quality substrates. Availability of DOC declined downriver and DOC in highly colored tributaries was of lower quality than DOC from other sites. In most cases, quality of DOC decreased at high discharge. (Author's abstract)
W91-12486

SEMIAUTOMATIC, WET-OXIDATION METHOD FOR THE DETERMINATION OF PARTICULATE ORGANIC NITROGEN COLLECTED ON FILTERS.
Centre d'Oceanologie de Marseille (France).
P. Raimbault, and G. Slawyk.
Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 405-408, March 1991. 3 fig, 1 tab, 12 ref.

Descriptors: *Chemical analysis, *Filters, *Laboratory methods, *Nitrogen, *Oxidation, *Water analysis, *Water chemistry, Nitrates, Nutrients, Peroxydisulfate, Phytoplankton, Technicon AutoAnalyzer.

The alkaline persulfate oxidation (i.e., wet oxidation) method for determining particulate organic nitrogen (PON) has been improved over the years and its merits discussed extensively. However, there remains a lack of knowledge concerning the oxidative capacities of peroxydisulfate against unknown aquatic organic matter. A wet-oxidation method with peroxydisulfate oxidation at 120 C was developed for routine analysis of PON collected on glass-fiber filters. The technique was adapted form a previous procedure for oxidizing total N in seawater to nitrate. Comparisons with PON determination by dry combustion at 800 C indicated high efficiency of the procedure, giving 100% recovery of N with cell cultures and natural seawater samples. Neutralizing buffer and pH adjustment proved to be necessary but were simplified by using a Technicon AutoAnalyzer system. The method was applied to follow nitrate assimilation by phytoplankton cultures and revealed excretion of N compounds by the cells at the end of the exponential phase of growth. The sensitivity of the method makes it possible to filter smaller quantities of seawater than needed for the combustion method (by 1-2 orders of magnitude) and can be adapted easily to shipboard use. (Author's abstract)
W91-12492

EFFECTS OF SEA SALTS ON THE FORMS OF NITROGEN RELEASED FROM ESTUARINE AND FRESHWATER SEDIMENTS: DOES ION PAIRING AFFECT AMMONIUM FLUX.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2L.
W91-12499

EFFECT OF SALINITY ON AMMONIUM SORPTION IN AQUATIC SEDIMENTS: IMPLICATIONS FOR BENTHIC NUTRIENT RECYCLING.
Academy of Natural Sciences of Philadelphia, PA. Div. of Environmental Research.
For primary bibliographic entry see Field 2L.
W91-12500

ION(NA)-HOLDING CAPACITY OF MICROBIAL BIOMASS UNDER SALINE CONDITIONS.
Tokyo Univ. of Agriculture and Technology (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 2L.
W91-12524

ENVIRONMENTAL EFFECTS ON CO2 EFFLUX FROM WATER TRACK AND TUSSOCK TUNDRA IN ARCTIC ALASKA, U.S.A.
Florida International Univ., Miami. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-12539

CHEMICAL COMPOSITION OF PRECIPITATION COLLECTED ON A WEATHERSHIP ON THE NORTH ATLANTIC.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Air Research.
E. Buijsman, P. J. Jonker, W. A. H. Asman, and T. B. Ridder.
Atmospheric Environment ATENBP, Vol. 25A, No. 5/6, p 873-883, 1991. 8 fig, 4 tab, 23 ref.

Descriptors: *Acid rain, *Air pollution effects, *Chemistry of precipitation, *North Atlantic, Analytical methods, Nitrogen, Sampling, Statistical analysis, Sulfur.

A 4-year research program was conducted to determine the chemical composition of precipitation in the North Atlantic Ocean. Sampling was carried out on the Dutch weather ship 'Cumulus', at 57 degrees N, 20 degrees W (location 'Lima') on a wet only basis. Samples from 110 precipitation events were analyzed for major organic ions. The collection of precipitation using three (or more) samplers was found to be a useful tool to detect contaminated samples. Ion balance calculations were inappropriate for quality control; their use led to an overestimate of concentration values, and therefore of deposition fluxes. An alternative statistical procedure is proposed based on the detection of contaminated samples from individual precipitation events. Arithmetic and median values were found to be suitable as estimators for average con-

centrations derived from the reduced data. Average concentrations of non sea salt derived components are 8.7 micromol/L H, 4.0 micromol/L NH4, 3.1 micromol/L NO3, and 4.1 micromol/L for sea salt corrected SO4. Based on the results of analysis of variance the 95% confidence intervals in these concentrations are approximately 20-50%. (Author's abstract)
W91-12540

SPATIAL AND TEMPORAL VARIABILITY OF RIME ICE AND SNOW CHEMISTRY AT FIVE SITES IN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
For primary bibliographic entry see Field 5A.
W91-12542

ESTIMATING CLOUD WATER DEPOSITION TO SUBALPINE SPRUCE-FIR FORESTS: I. MODIFICATIONS TO AN EXISTING MODEL.
Tennessee Valley Authority, Muscle Shoals, AL.
For primary bibliographic entry see Field 2B.
W91-12543

INNOVATIVE APPROACH TO DETERMINE RETARDATION FACTORS OF ORGANIC CONTAMINANTS IN GROUNDWATER SYSTEMS.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 5B.
W91-12626

NATURE AND RATES OF BACTERIAL METABOLISM IN THE AQUIFERS OF SOUTHEASTERN LOUISIANA.
Louisiana State Univ., Baton Rouge. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5B.
W91-12636

WATER QUALITY OF LAKES AND STREAMS IN VOYAGEURS NATIONAL PARK, NORTHERN MINNESOTA, 1977-84.
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W91-12654

DYNAMICS OF PHOTOTROPHIC BACTERIA IN RELATION TO IRON CYCLE IN A MEROMICTIC BASIN OF LAKE BANYOLES.
Institut d'Ecologia Aquatica, Gerona (Spain).
For primary bibliographic entry see Field 2H.
W91-12726

BENTHIC OXYGEN CONSUMPTION IN LAKE SUWA.
Nagano Prefecture Junior Coll. (Japan).
For primary bibliographic entry see Field 2H.
W91-12743

SURFACE WATER ACIDIFICATION: A COMPARISON OF METHODS FOR PH DETERMINATION IN WEAKLY BUFFERED NATURAL WATERS.
Freiburg Univ. (Germany, F.R.). Inst. fuer Physische Geographie.
For primary bibliographic entry see Field 7B.
W91-12775

MAJOR IONIC COMPOSITION IN THE SPANISH RESERVOIRS.
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W91-12799

CHANGES IN THE TROPHIC STATE OF THE SPANISH RESERVOIRS DURING THE LAST SIXTEEN YEARS.
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W91-12800

CHEMICAL REACTIONS OF METALS WITH HUMIC MATERIAL.
Institute of Terrestrial Ecology, Grange-over-Sands (England). Merlewood Research Station.
F. R. Livens.
Environmental Pollution ENPOEK, Vol. 70, No. 3, p 183-208, 1991. 6 fig, 1 tab, 158 ref.

Descriptors: *Chemical reactions, *Environmental chemistry, *Humic matter, *Literature review, *Metals, Detritus, Litter, Phenols, Quinones.

This literature review article presents information which stresses that humic substances are chemically very complex materials whose structure and reactions are not fully understood. Humic substances are believed to be macromolecules, spanning a wide range of molecular weights, which are formed from quinones and phenolic compounds; they contain a wide variety of functional groups, which may react with metals. Many different physical and chemical procedures have been used to study these interactions, and numerous different reaction mechanisms and products have been postulated. The colloidal properties of humic materials also affects their interactions with metals. Reaction with humic substances profoundly affects the environmental behavior of metals. Solubility, plant availability, and even volatility are all greatly influenced and can be either enhanced or reduced by these reactions. (Author's abstract)
W91-12808

RESIDENCE TIMES OF SURFACE WATER AND PARTICLE-REACTIVE 210-PB AND 210-PO IN THE EAST CHINA AND YELLOW SEAS.
Tokyo Univ. (Japan). Ocean Research Inst.
Y. Nozaki, H. Tsubota, V. Kasemsupaya, M. Yashima, and N. Ikuta.
Geochimica et Cosmochimica Acta GCACAK, Vol. 55, No. 5, p 1265-1272, May 1991. 8 fig, 3 tab, 25 ref. Ministry of Education, Science, and Culture, Japan Grants in Aid 63610004 and 01610003.

Descriptors: *East China Sea, *Geochemistry, *Lead radioisotopes, *Polonium radioisotopes, *Radium radioisotopes, *Sedimentation, *Surface water, *Water chemistry, *Yellow Sea, Chemical reactions, Environmental chemistry, Heavy metals, Lead, Mathematical studies, Mixing, Ocean circulation, Polonium, Radium, Upwelling.

228-Ra, 226-Ra, 210-Pb, and 210-Po were measured in the surface waters of the East China and Yellow Seas. Using mass balance equations for the Ra isotopes, the total flux of diffusion from sediments and desorption from suspended particles to be 0.1 dpm 226-Ra/sq cm/a and 1 dpm 228-Ra/sq cm/a, was estimated, and residence times to be 2-3 years for the waters on the East China Sea Shelf and 5-6 years for Yellow Sea waters. Box-model calculations yielded generally congruent scavenging residence times for 210-Pb and 210-Po in the waters of about 2 months on the shelf and about 7 months in the Kuroshio Current. These suggest that reactive heavy metals and pollutants discharged through rivers from the continent to the East Asian continental shelf are deposited mainly on the bottom sediments prior to transport to the pelagic ocean by lateral mixing. (Author's abstract)
W91-12814

HYDROCHEMISTRY ON THE YILGARN BLOCK, WESTERN AUSTRALIA: FERROLYSIS AND MINERALIZATION IN ACIDIC BRINES.
University Coll., London (England). Dept. of Geological Sciences.
J. M. McArthur, J. V. Turner, W. B. Lyons, A. O. Osborn, and M. F. Thirwall.
Geochimica et Cosmochimica Acta GCACAK, Vol. 55, No. 5, p 1273-1288, May 1991. 8 fig, 3 tab, 92 ref.

Descriptors: *Acidic water, *Australia, *Geochemistry, *Iron, *Playas, *Water chemistry, Acidity, Aluminum, Brines, Dry lakes, Environmental chemistry, Evaporation, Groundwater discharge, Groundwater quality, Hydrogen ion concentration, Hydrolysis, Kaolinite, Potassium, Silicon, Sulfates.

In the southeastern part of Western Australia internal drainage and a semi-arid climate have resulted in the extensive development of playas. The brines beneath the playas wedge outward and force local infiltration to crop out at playa margins as discharge zones. The discharging water contains dissolved Fe(2+), oxidation and hydrolysis (ferrolysis) of which generates very acidic water (pH $>/=$ 2.8). At least some of the alkalinity generated by the original reduction of Fe(3+) has been sequestered as subsurface calcrete within local soils. The acidity causes the dissolution of kaolinite, which is abundant in playa sediments and as a thick capping on weathered bedrock, giving water with a low pH and high concentrations of dissolved Al and Si. Evaporation, and mixing with playa brines containing high concentrations of K and SO4, causes alunite to precipitate as pH rises from a minimum of 2.8, at chlorinites of 1 to 2 M, to $>$ 6 at chlorinities of 4.8 M. The alunite deposits formed by this process are many orders of magnitude larger than occurrences elsewhere in the world. The large-scale mobilization of Si during this process may be one mechanism for the formation of silica-cemented rocks (silcrete) that are widespread in the Australian regolith. (Author's abstract)
W91-12815

FORMATION AND EVOLUTION OF SOILS FROM AN ACIDIFIED WATERSHED: PLASTIC LAKE, ONTARIO, CANADA.
University of Western Ontario, London. Dept. of Geology.
For primary bibliographic entry see Field 5C.
W91-12816

PHYSICO-CHEMICAL CHARACTERISTICS OF THE WATERS OF THE SANTA LUCIA RIVER BASIN (URUGUAY) (ESTUDIO DE LAS CARACTERISTICAS FISICO-QUIMICAS DEL AQUA DE UNA ZONA DEL RIO SANTA LUCIA (URUGUAY)).
Universidad de la Republica, Montevideo (Uruguay). Facultad de Humanidades y Ciencias.
For primary bibliographic entry see Field 5B.
W91-12840

HISTOLOGICAL GILL LESIONS ATTRIBUTABLE TO TOXICS IN ODONTHESTES BONARIENSIS (CUV. & VAL. 1835) (LESIONES HISTOLOGICAS BRANQUIALES ATRIBUIBLES A TOXICOS EN ODONTHESTES BONARIENSIS (CUV. Y VAL., 1835) (PISCES, ATHERINIDAE)).
Departamento de Biopatologia, Fundacion Centro de Invest. Biomedicas, Albert Einstein, Luis Viale 2831, (1416) Capital Federal, Rep. Argentina.
L. A. Romano, and F. Cueva.
Revista de la Asociacion de Ciencias Naturales del Litoral RCNLDW, Vol. 19, No. 2, p 135-142, 1988. 5 fig, 18 ref. English summary.

Descriptors: *Argentina, *Fish pathology, *Gills, *Laguna de Chascomus, *Water pollution effects, Electron microscopy, Microscopic analysis, Microscopy, Path of pollutants, Tissue analysis.

A series of branchial alterations of 22 specimens of Odonthestes bonariensis taken from the Chascomus lagoon (Argentina) were studied with optical and electronic microscopy. The histological modifications were classified into two types: Type I, shortening and edema of the secondary lamella; Type II, rupture of the pilar cells with telangiectatic phenomena; Type III, epithelial hyperplasia; and Type IV, mucous hyperplasia and metaplasia. The presence of infectious agents was ruled out and the injuries were considered to result from chemical toxics. The results indicate a considerable degree of pollution exists in the waters of Chascomus lagoon. (Author's abstract)
W91-12841

(BIO)GEOCHEMICAL REACTIONS IN AQUIFER MATERIAL FROM A THERMAL ENERGY STORAGE SITE.
Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology.
For primary bibliographic entry see Field 2K.
W91-12858

(BIO)GEOCHEMICAL REACTIONS IN AQUIFER MATERIAL FROM A THERMAL ENERGY STORAGE SITE.
Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology.
H. J. Brons, J. Griffioen, C. A. J. Appelo, and A. J. B. Zehnder.
Water Research WATRAG, Vol. 25, No. 6, p 729-736, June 1991. 6 fig, 4 tab, 31 ref. Dutch Programme for Energy Research contract no. 23.14-021.10.

Descriptors: *Aquifer characteristics, *Fulvic acids, *Geochemistry, *Groundwater chemistry, *Heat storage, *Thermal energy, Calcium, Carbon dioxide, Carbonates, Chemical oxygen demand, Clays, Magnesium, Sand, Temperature effects, Volatile solids.

The mobilization of organic compounds and the release of CO2 was studied in aquifer material from a site chosen for thermal energy storage. These processes have been measured aerobically and anaerobically within a temperature range of 4-95 C in sediment samples consisting of either quartz-rich coarse sand or peaty clay. At temperatures above 45 C organic carbon compounds, including fulvic acids, were mobilized from both sediments resulting in an increased chemical oxygen demand of the water phase. Complexation of calcium and magnesium by fulvic acids resulted in the supersaturation of the water phase with regard to calcite and colomite and thus prevented the precipitation of these carbonates. The highest rates of CO2 release were observed during the first 4 days. Aerobically, the maximum velocity for CO2 formation varied between 355 and 800 (sand) or 15 and 150 (peaty clay) micromoles CO2 per gram volatile solids per day . Anaerobically, similar rates were observed, namely 25-500 (sand) and 10-110 (peaty clay) micromoles CO2 per g volatile solids. At temperatures above 55 C, CO2 was produced purely chemically. (Author's abstract)
W91-12858

INTERLABORATORY TEST FOR THE DETERMINATION OF S-TRIAZINES IN WATER SAMPLES (ZWEITE VERGLEICHSUNTERSUCHUNG ZUR BESTIMMUNG VON S-TRIAZINEN IN WASSERPROBEN).
For primary bibliographic entry see Field 5A.
W91-12863

NEW METHOD FOR MEASURING THE HARDNESS OF WATER.
Humboldt-Univ. zu Berlin (German D.R.). Fachbereich Chemie der.
H. Grossmann, W. Moritz, J. Szeponik, and C. Borchert.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 24, No. 2, p 76-80, April 1991. 6 fig, 1 tab, 10 ref.

Descriptors: *Analytical methods, *Chemical properties, *Hardness, *Monitoring, *Water analysis, *Water treatment, Calcium, Drinking water, Fluorides, Ion-selective electrodes, Laboratory methods, Water quality, Water quality management.

A method for water hardness determination was developed which has a good long-term stability, is as fast as the current calcium ion-selective membrane electrode method, is precise enough for routine measurements and makes automation possible. The techniques utilizes calcium ion sensor device consisting of an adsorber reactor (activated Al2O3), flow through reactor (CaF2 granulate) and fluoride ion detector (ISE or ISFET), and measures the hardness of water continuously. Flow through conditions as well as chemical and mechanical properties of the CaF2 were optimized. This was necessary to guarantee the desired properties of dissolution rate, grain size and surface durability. The sensor device permits measurement of the hardness of tap water with a deviation of less than 5%, and a response time of less than 1 minute. (Author's abstract)
W91-12865

DIAZIDO(4,4')-DISULFO(2,2')-STILBEN-IMPREGNATED SORPTION LAYERS IN THE THIN LAYER CHROMATOGRAPHY FOR THE ANALYSIS OF PHENOLIC COMPOUNDS IN WATER (DIAZIDO(4,4')-DISULFO(2,2')-STILBENIMPRAGNIERTE SORPTIONSSCHICHTEN FUR DIE DUNNSCHICHTCHROMATOGRAPHIE ZUR PHENOLANALYTIK VON WASSERN).
Med.-Techn. Bereiches Kreiskrankenhaus Treuenbrietzen, 1701-Treuenbrietzen, Juterboger Str. 68, Germany.
For primary bibliographic entry see Field 5A.
W91-12867

VERTICAL FLUXES OF VOLATILE MERCURY OVER FOREST SOIL AND LAKE SURFACES IN SWEDEN.
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Inorganic Chemistry.
For primary bibliographic entry see Field 5B.
W91-12901

8-YEAR RECORD OF THE SEASONAL VARIATION OF 2-H AND 18-O IN ATMOSPHERIC WATER VAPOUR AND PRECIPITATION AT HEIDELBERG, GERMANY.
Heidelberg Univ. (Germany, F.R.). Inst. fuer Umweltphysik.
H. Jacob, and C. Sonntag.
Tellus TELLAL, Vol. 43, No. B3, p 291-300, July 1991. 3 fig, 2 tab, 11 ref.

Descriptors: *Air pollution, *Atmospheric water, *Deuterium, *Environmental chemistry, *Environmental tracers, *Heidelberg, Chemical analysis, Germany, Historic data, Seasonal variation, Temperature, Transpiration.

Continuous time series of delta-deuterium and delta-18-O in atmospheric water vapor and precipitation at Heidelberg are presented for the years 1981 to 1988. It is often not possible to derive the isotopic composition of the water vapor from the isotopic composition of precipitation for individual months. However, a close relationship does not exist between the isotopic composition of the vapor and the precipitation on a time-scale of a few years. The correlation of isotopic composition with temperature is much better for the vapor data than for the precipitation data. The change in delta/change in temperature relationship of the seasonal variations is itself a function of temperature, being much lower during warmer periods than during cold periods. During summer months, the admixture of water vapor originating from plant transpiration plays an important role in biasing the change in sigma/change in temperature relationship toward lower values. This effect complicates the calculation of paleotemperatures using isotopic data. (Author's abstract)
W91-12902

AQUEOUS GEOCHEMISTRY OF CHROMIUM: A REVIEW.
Bureau de Recherches Geologiques et Minieres, Orleans (France). Geochemistry Dept.
F. C. Richard, and A. C. M. Bourg.
Water Research WATRAG, Vol. 25, No. 7, p 807-816, July 1991. 8 fig, 2 tab, 78 ref, append. Commission of European Communities Project EV4V-0146-F.

Descriptors: *Chromium, *Geochemistry, *Literature review, *Path of pollutants, *Water chemistry, Chemical speciation, Dissolved oxygen, Environmental chemistry, Minerals, Natural waters.

The aqueous geochemistry of chromium is analyzed in this literature review. The chromium content of natural waters is generally low whereas rocks exhibit a wide range of Cr concentrations. In natural environments, the most stable oxidation state of Cr are Cr(III) and Cr(VI). The following minerals can control the dissolved Cr content of natural waters: Cr(OH)3(s) and (Fe, Cr)(OH)3(ss) for Cr(III). Major Cr(III) dissolved species are CrOH(2+) and Cr(OH)3, as well as several organic and a few inorganic complexes, whereas HCrO4(-) and CrO4(2-) are the main forms of Cr(VI) in natural waters. The Cr distribution is also controlled by redox processes. Oxidation of Cr(III) to Cr(VI), poor with dissolved oxygen, is very effective in the presence of solid MnO2. Fe(II)-, and organic matter-rich environments favor the reduction of Cr(VI) to Cr(III). Interaction with solid phases can also regulate the Cr content of water. Cr(III) exhibits a typical cationic sorption behavior. Its adsorption increases with pH, but decreases when competing cations are present. Chromium(VI), on the other hand, exhibits a typical anionic sorption behavior. Its adsorption decreases with increasing pH and when competing dissolved anions are present. The migration of Cr is determined by the competition between complexation, dissolution/precipitation, redox processes and adsorption/desorption mechanisms. Cr(III) will migrate under acidic conditions and/or if present as dissolved organic matter complexes. Hexavalent Cr generally migrates rapidly but its mobility is inhibited when the Fe(II) and organic matter concentrations are high and when sorption processes are favored (low pH). (Author's abstract)
W91-12910

DETERMINATION OF RHODAMINE WT IN SURFACE WATER BY SOLID-PHASE EXTRACTION AND HPLC WITH FLUORESCENCE DETECTION.
Ministry of Transport and Public Works, Middelburg (Netherlands). Tidal Waters Div.
J. W. Hofstraat, M. Steendijk, G. Vriezekolk, W. Schreurs, and G. J. A. A. Broer.
Water Research WATRAG, Vol. 25, No. 7, p 883-890, July 1991. 5 fig, 13 ref.

Descriptors: *Chemical analysis, *Dyes, *Extraction, *Groundwater movement, *High performance liquid chromatography, *Path of pollutants, *Rhodamine, *Streamflow, *Surface water, Fluorescence, Laboratory methods, Water chemistry.

A technique is described for the sensitive and selective determination of Rhodamine WT water tracer, based on the combined application of solid-phase extraction (SPE) using a C18-column and HPLC separation with fluorescence detection for analysis, has important advantages over direct fluorometric techniques. The approach presented is, in essence, a zero background method, so that much lower concentrations of dyes can be measured. The SPE step provides a means to further improve the detection limit. For clean waters, detection limits in the sub-ppt (parts per thousand) (in the order of 10 pg/L) are easily attainable. In addition, the SPE-HPLC procedure does not suffer from the disturbances of environmental circumstances, like pH, salinity, temperature, chlorine concentration and presence of suspended matter and algae, that may interfere with direct fluorometric determinations. The HPLC-based approach appears to be a rugged and accurate method with a long-term repeatability of better than 5%. (Author's abstract)
W91-12919

2L. Estuaries

INTRATIDAL VARIABILITY OF LIVING AND DETRITAL SESTON COMPONENTS IN THE INNER PART OF THE WESER ESTUARY: VERTICAL EXCHANGE AND ADVECTIVE TRANSPORT.
Bremen Univ. (Germany, F.R.).
B. Schuchardt, and M. Schirmer.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 1, p 21-41, March 1991. 3 fig, 1 tab, 62 ref.

Descriptors: *Advection, *Detritus, *Estuaries, *Germany, *Phytoplankton, *Seston, *Weser estu-

ary, Aquatic bacteria, Particulate matter, Tidal effects, Tides, Turbidity, Vertical distribution.

The behavior of several organic seston components is described during an axial survey and at two anchor stations within the inner part of the Weser Estuary. It was partly possible to attribute observed changes during the tidal cycle to either vertical exchange or advective transport of spatial gradients. Vertical exchange is apparently the predominant mechanism for intratidal variability of particulate organic matter, attached bacteria and phaeopigments, whereas tidal advection is predominant for free bacteria and living phytoplankton. Components showing no vertical exchange during the tidal cycle are not accumulated within the turbidity maximum and vice versa. It is concluded that the turbidity maximum of the mesotidal Weser Estuary is particle selective and that physical processes are essential in determining spatial distribution and transport of living and detrital seston components and therefore the structure of the estuarine ecosystem. (Author's abstract)
W91-11616

COMPARATIVE ECOLOGY OF ESTUARIES IN NIGERIA.
Nigerian Inst. for Oceanography and Marine Research, Lagos.
A. A. Amadi.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 27-38, December 1990. 4 fig, 2 tab, 31 ref.

Descriptors: *Baseline studies, *Estuaries, *Estuarine environment, *Fish populations, *Food habits, *Nigeria, *Species composition, *Tropical areas, Cichlid, Deltas, Estuarine fisheries, Mangrove trees, Marine environment, Population dynamics, Rivers, Salinity.

Problems arising from beach erosion, oil spills, coastal engineering, and the spread of the water hyacinth have contributed to current awareness of fragility of estuarine ecosystems in Nigeria, but ecological research has not always kept pace with abuses to the environment. In order to evaluate the relationship between estuary structure and the function of the biotic community, a bar-built estuary, a drowned river valley and two river delta estuaries were compared and contrasted to show the impact of some abiotic factors, notably climate, salinity, and oxygen on the distribution of the aquatic fauna and flora. Salinity was recognized as the key factor responsible for the population dynamics in these habitats. The mangrove community is characteristically zoned, but development and distribution of the trees is restricted, due to geomorphic and hydrological processes, to the western banks of the estuaries. Marine fish species dominated the estuaries, but some prolific-breeding cichlids from freshwater were observed. Forty-eight species of bony fishes were recorded in Lagos Lagoon, the Escravos, and Qua Ibo estuaries and classified by salinity tolerance into stenohaline and euryhaline marine species (66%), and freshwater species (34%). The same estuarine ichthyofauna were split into trophic groups: piscivores (46%), zooplankton feeders (10%), meiobenthos feeders (27%),and macrobenthos feeders (17%). (Brunone-PTT)
W91-11623

REVIEW OF SOME CHARACTERISTICS OF FRESHWATER AND COASTAL ECOSYSTEMS IN GHANA.
Institute of Aquatic Biology, Achimota (Ghana).
C. A. Biney.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 45-53, December 1990. 2 fig, 4 tab, 21 ref.

Descriptors: *Aquatic environment, *Coastal lagoons, *Coasts, *Ghana, *Lakes, *Rivers, Alkalinity, Brackish water, Eutrophication, Hydrogen ion concentration, Nutrient concentrations, Oxygen requirements, Phytoplankton, Sediment chemistry, Transparency, Turbidity, Water pollution sources.

Data collected over a ten-year period provide a review of some characteristics of freshwater and coastal ecosystems in Ghana. Studies were conducted on two recently formed man-made lakes, one river, five coastal lagoons and waters along the ocean front. Freshwaters had near neutral pH while coastal waters were alkaline. In both ecosystems, the pH of sediments were lower than those of corresponding waters. While the transparency of coastal waters varied within narrow limits, large variations were observed in freshwaters. The lowest concentration of nutrients occurred in the river and the highest in coastal waters. In general, differences in these physical and chemical characteristics do not depend on whether the aquatic systems were fresh, brackish or saline, but are more influenced by factors as whether a water body: (1) was lotic or lentic, (2) was influenced by industrial or domestic activities, (3) was affected by impoundment, (4) received turbid water inflows, or (5) was eutrophic. (Author's abstract)
W91-11625

COASTAL MARINE ECOSYSTEMS OF MAURITIUS.
Mauritius Univ., Reduit. School of Agriculture.
I. Fagoonee.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 55-62, December 1990. 2 fig, 1 tab, 19 ref.

Descriptors: *Coastal waters, *Ecosystems, *Lagoons, *Marine animals, *Marine plants, *Mauritius, *Reefs, *Species diversity, *Water pollution sources, Aquaculture, Bays, Estuaries, Fisheries, Geochemistry, Industrial development, Mangrove trees, Nonpoint pollution sources, Public opinion, Water pollution effects, Wave height, Wetlands, Zonation.

The coastal ecosystems of Mauritius island (1850 sq km, 20 degrees South and 57 degrees East, Indian Ocean) consist of lagoons, reefs, estuaries, mangroves, salt water wetlands, and sheltered bays. There is a paucity of qualitative and quantitative data on these ecosystems. Fringing reefs almost completely surround the volcanic island, enclosing a series of lagoons of variable depths (1 to 4 m). Tides are not important but wave heights can reach 3 m. The zonation of lagoons is seen in a transect from the beach towards the open sea, together with the zonal distribution of the flora and fauna, the types of corals and sediments, the detrital sediment composition, the different hydrodynamic processes acting on the benthic sediments, as well as the geochemical (redox) processes. A rich algal biomass is present which shows seasonal variation. Two species of mangroves, Rhizophora mucronata and Bruguiera gymnorrhiza exist. Fish and shellfish culture is practiced in enclosed ponds (barachois). Commercial exploitation of the lagoonal fisheries and other anthropogenic factors have contributed to reef stress and degradation. Industrial development and agricultural activities are accompanied by effluent discharges and soil runoff, inorganic pollution by heavy metals, effluents from chemical and other industries, sewage, thermal pollution, etc. Fringing reefs are particularly vulnerable to pollutants and sediments washed from the land. Public awareness is being aroused to safeguard the coastal environment. (Brunone-PTT)
W91-11626

PHYTOPLANKTON FLORA IN THE WARRI/FORCADOS ESTUARY OF SOUTHERN NIGERIA.
Benin Univ., Benin City (Nigeria). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W91-11630

NONLINEAR BAROTROPIC TIDES AND BORES IN ESTUARIES.
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 8B.
W91-11642

ESTABLISHING BIOSPHERE RESERVES FOR COASTAL BARRIER ECOSYSTEMS.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
G. C. Ray, and W. P. Gregg.
Bioscience BISNAS, Vol. 41, No. 5, p 301-309, May 1991. 5 fig, 32 ref.

Descriptors: *Barrier islands, *Biosphere reserves, *Coastal plains, *Coastal zone management, *Conservation, *Ecosystems, Atlantic coast, Education, Monitoring, Public policy, Research, Socioeconomic aspects.

The US Man and the Biosphere (MAB) program emphasizes interdisciplinary research relevant to policy, particularly on issues of biodiversity, sustainable human use, and global climate and ecological change. Within the MAB, 46 designated biosphere reserves on the Atlantic coast provide areas for demonstrating that conservation and sustained resource use can be mutually reinforcing. The emphasis on research, monitoring, and education distinguishes biosphere reserves from other types of conservation areas. Major research questions currently focus on how physical and biological, terrestrial and aquatic, and atmospheric and oceanic processes interact to maintain coastal barrier ecosystems. Equally important are questions about how natural and socioeconomic processes interact. Understanding these relationships has enormous importance for conservation and commercial and recreational attributes of the ecosystems and for sustaining the free services of natural systems, such as the sequestration and detoxification of pollutants. Biosphere-reserve implementation in coastal-marine environments has been slow, in part due to the complexity of simultaneously optimizing protection of biological diversity and human use of resources. Reconciliation of these apparently conflicting objectives may be the ultimate challenge of contemporary ecosystem management. To meet this challenge, ecological and socioeconomic optimization models are needed to help plan and implement sustainable uses of ecosystems. These models can best be tested and refined in established biosphere reserves where technical, logistical, and management capabilities can be assembled to accommodate a wide variety of situations. (Sand-PTT)
W91-11643

LONG-TERM RESEARCH AT THE VIRGINIA COAST RESERVE.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
B. P. Hayden, R. D. Dueser, J. T. Callahan, and H. H. Shugart.
Bioscience BISNAS, Vol. 41, No. 5, p 310-318, May 1991. 10 fig, 24 ref. NSF Grant BSR 8702333-02.

Descriptors: *Barrier islands, *Biosphere reserves, *Coastal plains, *Coastal zone management, *Conservation, *Model studies, *Stochastic models, Atlantic coast, Ecosystems, Forest ecosystems, Monitoring, Research, Virginia.

The Virginia Coast Reserve has been designated a biosphere reserve by the US Man and the Biosphere program and is a National Science Foundation Long-Term Ecological Research (LTER) site. Research focuses on three processes: succession, disturbance, and system-state change. Most of the LTER monitoring, observational and experimental research, and deterministic modeling focus on quasi-equilibrium, or steady-state, dynamics. The state variables monitored include above-ground net primary production, below-ground organic carbon accumulation, seasonal and longer-term floristic changes, elevations of fresh and saltwater tables, and biogeochemical fluxes. Experimental studies are also focused on quasi-equilibrium ecosystem processes. These research activities identify essential state variables of the system, which are used in the computer models being developed. Research on system perturbations is based on three types of external perturbations: periodic, i.e., those with return periods of less than one year, which include the annual, diurnal, and tidal cycles; episodic, such as severe weather, species extinction, and alterations in land-use practice; and trend, such as relative sea-level rise and systematic changes in storm frequency. A forest stand simulation model (FORET) has been used to investigate conditions of the Virginia coastal plain boreal forest of 18,000 years ago; FORET models for the current mari-

time forests are under development, so historical and projected climate changes can be assessed in terms of contemporary barrier island forests. Contemporary island dynamics is being studied using a stochastic/deterministic model (ISLAND) of island geomorphology, hydrology, and ecology. Model output statistics from ISLAND will be useful in developing stochastic estimates of suitable colony habitat extent under various scenarios of environmental change. (Sand-PTT)
W91-11644

PUBLIC EDUCATION FOR PROTECTING COASTAL BARRIERS.
Ohio State Univ., Columbus. School of Natural Resources.
For primary bibliographic entry see Field 6A.
W91-11645

MANAGEMENT OF COASTAL BARRIER BIOSPHERE RESERVES.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 6A.
W91-11646

MACROBENTHIC ASSOCIATIONS OF HAIFA BAY, MEDITERRANEAN COAST OF ISRAEL.
Israel Oceanographic and Limnological Research Ltd., Haifa.
M. Tom, and B. Galil.
Marine Ecology (PSZNI) MAECDR, Vol. 12, No. 1, p 75-86, 1991. 4 fig, 2 tab, 19 ref.

Descriptors: *Benthic fauna, *Haifa Bay, *Mediterranean, Bottom sediments, Israel, Marine environment, Spatial distribution, Species composition.

Species composition, distribution, and relative abundance of the macrobenthic fauna were examined at Haifa Bay, on the Mediterranean coast of Israel. Samples were taken at 20 sites ranging in depth from 10-80 m during a two-year period (1974-75). Fauna was sampled by a 1.15 m beam trawl and sediment was sampled by a 0.1 sq m Petersen grab. Five types of soft substrate were distinguished within the study area. Two features characterize the bottom: increasing silt-clay percentage with depth and the occurrence of a clay-silt substrate with a significant coarse sand fraction. Between 47-75 m, the muddy bottom is strewn with cobble-sized bioherms composed of animal shells and calcareous algae. The surface of these structures was occupied by live sessile fauna, and their microscopic examination revealed closed cavities filled with fine-grained sediment. This suggests in situ formation of the bioherms on the muddy substrate. Classification of the faunal data using clustering analysis produced hierarchical grouping of sites and species displayed as dendrograms. Ten sample groups and 11 species associations were identified. Species composition is related to sediment type and in the 25-30 m range shows seasonality. A unique species association is associated with the bioherms. A comparison of these results with those based on sampling carried out in 1953-56 reveals massive penetration into Haifa Bay of four Indo-Pacific species, the gastropods Rhinoclavis kochi and Minolia nedyma, the decapod Charybdis longicollis, and the ophiurid Ophiactis parva. (Author's abstract)
W91-11656

EPIZOOTIOLOGY AND DISTRIBUTION OF TRANSMISSIBLE SARCOMA IN MARYLAND SOFTSHELL CLAMS, MYA ARENARIA, 1984-1988.
National Marine Fisheries Service, Oxford, MD. Oxford Lab.
For primary bibliographic entry see Field 5C.
W91-11666

GERMINOMAS AND TERATOID SIPHON ANOMALIES IN SOFTSHELL CLAMS, MYA ARENARIA, ENVIRONMENTALLY EXPOSED TO HERBICIDES.
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W91-11667

CARCINOGENICITY OF BLACK ROCK HARBOR SEDIMENT TO THE EASTERN OYSTER AND TROPHIC TRANSFER OF BLACK ROCK HARBOR CARCINOGENS FROM THE BLUE MUSSEL TO THE WINTER FLOUNDER.
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W91-11668

UNDERWAY DOPPLER CURRENT PROFILES IN THE GULF OF CALIFORNIA.
Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (Mexico).
A. Badan-Morgan, M. C. Hendershott, and M. F. Lavin.
EOS EOSTAJ, Vol. 72, No. 19, p 209-218, May 1991. 5 fig, 33 ref.

Descriptors: *Doppler current, *Gulf of California, *Ocean circulation, *Tidal currents, *Water currents, Ballenas Channel, Heat flow, Mixing, Vertical mixing, Water temperature, Wave velocity.

The circulation of the Gulf of California is unusually influenced by the mixing generated by strong tidal currents. The most recent Pichicuco cruise was focused primarily on the region in and around the channels, and on the shallow northern Gulf. The deep water in Ballenas channel is much warmer and hence lighter than that found just south of San Lorenzo sill, which is due to the strong vertical mixing in the channel and to the large heat flux through its surface. Ballenas Channel appears important in the total exchange of water between the central Gulf and the northern Gulf, but quantification of the volume of deep water entering the Ballenas Channel over San Lorenzo sill gets into the far northern Gulf over the north sill. Acoustic Doppler Current Profile (ADCP) results show deep subtidal flow toward the northern Gulf and outflow in the upper layers, and provide an idea of the distribution of these currents across the channels. Not much of the deep inflow over the Salsipuedes sill appears to extend through Ballenas channel into the northern Gulf. Much of the heat gained by the northern Gulf must be removed through San Esteban and Tiburon channels. Flow supercritical with respect to the first internal mode appeared to occur over most silts at spring tides. The ADCP was able to bottom track reliably to depths greater than 500 m and, in regions of high zooplankton concentrations and with proper precautions for the avoidance of bubbles, return water velocity data from similar depths. With moderate averaging over ensembles to reduce depth-coherent fluctuations separated from the motion of the ship, such an ADCP can resolve low-mode internal wave vertical velocities a few centimeters per second in amplitude. (Brunone-PTT)
W91-11682

NUTRIENT DYNAMICS AND PELAGIC FOOD WEB INTERACTIONS IN OLIGOTROPHIC AND EUTROPHIC ENVIRONMENTS: AN OVERVIEW.
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 5G.
W91-11683

CONTRIBUTION OF THE WATER-SEDIMENT INTERFACE TO THE TRANSFORMATION OF BIOGENIC SUBSTANCES: APPLICATION TO NITROGEN COMPOUNDS.
Centre Univ. de Luminy, Marseille (France).
R. Daumas.
Hydrobiologia HYDRB8, Vol. 207, p 15-29, November 22, 1990. 7 fig, 4 tab, 85 ref.

Descriptors: *Benthic environment, *Bioturbation, *Limnology, *Microorganisms, *Nitrogen, *Sediment chemistry, *Sediment-water interfaces, Bacteria, Biopolymers, Bottom water, Enzymes, Organic matter, Particle size, Sediment physical properties, Sedimentation, Water chemistry, Water column.

The water-sediment interface (WSI) has not been considered as a theoretical frontier between two phases, but as a variable layer comprising the overlying bottom water, the superficial sediment, and the bioturbed sediment. This heterogeneous benthic boundary layer forms a non-equilibrated assemblage of an aqueous phase, a mineral phase influencing the exchanges, and a dissolved gaseous phase regulating biological activity, detrital organic matter present as dissolved or adsorbed compounds and particles, and a living benthic community dominated by microorganisms. Biological activity and the equilibrium between these components are linked to depth, bottom currents, primary production and allochtonous inputs of organic matter. The settling rate of particulate matter in the water column, which depends on both the size and density of particles, is also an important factor. Settled organic matter is broken down mainly by exoenzymes linked to the bacterial membrane. Other heterotrophic organisms, like flagellates and ciliates, contribute to the activity of bacterial populations or to a modification of the physical and chemical characteristics of organic matter like macrofauna. Bacterial activity in the WSI is one to two orders of magnitude higher than in overlying bottom water, depending on the density of the bacterial population, on the amount of available organic matter, and on the presence of predators grazing on bacteria and macrofauna and increasing oxygen and dissolved substrates. The WSI is now considered as a sink for particulate matter and biopolymers, and/or as a sink or source for organic monomers and NH(+4) depending on their concentration. During the last decade, intensive work has been performed in the field, but progress has been slow due to the heterogeneity of the layer and the adsorptive properties of the mineral fraction. (Author's abstract)
W91-11684

DYNAMICS OF BACTERIOPLANKTON IN OLIGOTROPHIC AND EUTROPHIC AQUATIC ENVIRONMENTS: BOTTOM-UP OR TOP-DOWN CONTROL.
Groupe de Microbiologie des Mileux Aquatiques, Brussels (Belgium).
G. Billen, P. Servais, and S. Becquevort.
Hydrobiologia HYDRB8, Vol. 207, p 37-42, November 22, 1990. 6 fig, 1 tab, 15 ref.

Descriptors: *Bacteria, *Eutrophy, *Limnology, *Meuse River, *North Sea, *Oligotrophy, *Population dynamics, *Scheldt Estuary, *Southern Ocean, Aquatic habitats, Bacterial physiology, Biomass, Comparison studies, Limiting nutrients, Model studies, Mortality, Organic matter, Predation.

Measurements of bacterial biomass, production and mortality have been carried out in a wide range of aquatic environments, including eutrophic and oligotrophic ones. The general variation trends of bacterial biomass, size, specific growth rate and mortality rate in all these environments are examined in the Scheldt estuary, the Meuse River, the North Sea, and the Southern Ocean. The overall flux of bacterial production is taken as an index of the flux of organic matter available to bacteria, thus characterizing the richness of the environment. Bacterial biomass is roughly proportional to richness, while mean cell size increases with it. The turnover rate of biomass, as revealed either by growth or by mortality rates, appeared to be fairly independent of richness. These observations are compatible with a simple resource-limited (bottom-up controlled) model of the dynamics of bacterioplankton. On the other hand, these results contradict the predictions of a predator-controlled (top-down controlled model). (Author's abstract)
W91-11686

TROPHIC STRUCTURE AND PRODUCTIVITY OF THE LAGOONAL COMMUNITIES OF TIKEHAU ATOLL (TUAMOTU ARCHIPELAGO, FRENCH POLYNESIA).

Centre d'Oceanologie de Marseille (France).
L. Charpy, and C. J. Charpy-Roubaud.
Hydrobiologia HYDRB8, Vol. 207, p 43-52, November 22, 1990. 3 fig, 3 tab, 37 ref.

Descriptors: *Atolls, *Carbon cycle, *Detritus, *Food chains, *French Polynesia, *Lagoons, *Particulate matter, *Plankton, *Productivity, Aquatic bacteria, Biomass, Dominance, Organic carbon, Particle size, Phytoplankton, Tuamotu Archipelago, Zooplankton.

Carbon standing stocks and fluxes were studied in the lagoon of Tikehau atoll (Tuamotu archipelago, French Polynesia), from 1983 to 1988. The average particulate organic carbon (POC) concentrations (0.7 to 2000 microm) was 203 mg C/cubic m. The suspended living carbon (31.6 mg C/cubic m) was made up of bacteria (53%), phytoplankton <5 microm (14.2%), phytoplankton >5 microm (14.2%), nanozooplankton 5 to 35 microm (5.7%), microzooplankton 35 to 200 microm (4.7%) and mesozooplankton 200 to 2000 microm (7.9%). The microphytobenthos biomass was 480 mg C/sq m. Suspended detritus (84.4% of the total POC) did not originate from the reef flat out from lagoonal primary productions. Their sedimentation exceeded phytobenthos production. Fifty percent of bacterial biomass was adsorbed on particles. The bacterial biomass dominance was explained by the utilization of (1) DOC excreted by phytoplankton (44 to 175 mg C/sq m/day) and zooplankton (50 mg C/sq m/day), (2) organic compounds produced by solar-induced photochemical reactions, and (3) coral mucus. Fifty percent of the phytoplankton biomass belongs to the <5 microm fraction. This production (440 mg C/sq m/day) exceeded phytobenthos production (250 mg C/sq m/day) when the whole lagoon was considered. The zooplankton >35 microm ingested 315 mg C/sq m/day, made up of phytoplankton, nanozooplankton and detritus, with production of 132 mg C/sq m/day. The detritus <35 microm represent the most important particulate organic carbon pool in the lagoon. Direct measurements of bacterial biomass, bacterial and nanozooplankton productions and nanoplankton and phytoplankton excretions could complete this carbon cycle. (Author's abstract)
W91-11687

RELATIONSHIPS BETWEEN TROPHIC ORGANIZATIONS OF BENTHIC COMMUNITIES AND ORGANIC MATTER CONTENT IN TYRRHENIAN SEA SEDIMENTS.
Comitato Nazionale per l'Energia Nucleare, La Spezia (Italy).
S. Cocito, S. Fanucci, I. Niccolai, C. Morri, and C. N. Bianchi.
Hydrobiologia HYDRB8, Vol. 207, p 53-60, November 22, 1990. 4 fig, 1 tab, 33 ref.

Descriptors: *Benthic organisms, *Biomass, *Italy, *Organic matter, *Sediment chemistry, *Trophic level, *Tyrrhenian Sea, Carbon cycle, Elba Island, Food stress, Leghorn Island, Nitrogen.

The organic content of sediments, often considered as an important trophic source for the benthos, can be used as a measurement of the trophic status of marine ecosystems. Soft-bottom communities were studied between Leghorn and Elba Island (Italy), from 5 to 500 m depth. Total biomass and trophic structure (percent dominance of trophic guilds) were reduced to organic carbon content and carbon-nitrogen ratio of sediments. Sediment organic matter, depending on its quantity and quality, could act as a food source or a stress source for the community. The positive correlation between organic carbon and carbon-nitrogen ratio on sediments showed that sediment organic matter accumulates mainly as refractory matter, and thus cannot be considered as an important food source for infauna. The relationships between benthic consumers and organic matter do not follow a single pattern: a mosaic of situations exists, in which the energetic input of sediment organic matter could in turn act as a feeding or stress source, depending on quality and quantity, and on a number of abiotic and biotic factors. (Brunone-PTT)
W91-11688

EFFECTS OF A PLUME FRONT ON THE DISTRIBUTION OF INORGANIC AND ORGANIC MATTER OFF THE RHONE RIVER.
Centre d'Oceanologie de Marseille (France).
M. Leveau, F. Lochet, M. Goutx, and F. Blanc.
Hydrobiologia HYDRB8, Vol. 207, p 87-93, November 22, 1990. 4 fig, 3 tab, 25 ref.

Descriptors: *Estuaries, *France, *Inorganic matter, *Mediterranean Sea, *Organic matter, *Particulate matter, *Plumes, *Rhone River, *Saline-freshwater interfaces, *Suspended solids, Boundary layers, Cycling nutrients, Dilution, Flocculation, Lipids, Phytoplankton, Sorption.

Hydrological structures off the Rhone River estuary resulting from the introduction of the river flow into the Mediterranean Sea show a frontal envelope corresponding to the vertical limit of the dilution zone. The freshwater/seawater interface has often been described as a barrier zone, in which the processes of diffusion, flocculation, sorption and complexation occur. The concentration of dissolved inorganic matter and dissolved lipids did not increase at the interface. In contrast, a strong accumulation in the mineral and organic, living and non-living, particulate matter occurred. An obvious increase in chlorophyll content and in some particulate lipids enabled the detection of accumulation of a phytoplanktonic biomass at the interface. Results show that production and accumulation of particulate matter increase at the freshwater/seawater increase of the River Rhone dilution plume. Utilization of this material by higher trophic levels may cause a significant rate of organic production and should thus be considered when studying large-scale effects of Rhone River water inputs on nutrient fluxes and the functioning of food webs in general. (See also W91-11692) (Brunone-PTT)
W91-11691

TRANSFERS BETWEEN A EUTROPHIC ECOSYSTEM, THE RIVER RHONE, AND AN OLIGOTROPHIC ECOSYSTEM, THE NORTHWESTERN MEDITERRANEAN SEA.
Centre d'Oceanologie de Marseille (France).
F. Lochet, and M. Leveau.
Hydrobiologia HYDRB8, Vol. 207, p 95-103, November 22, 1990. 7 fig, 1 tab, 35 ref.

Descriptors: *Eutrophy, *Mediterranean Sea, *Nutrient transport, *Oligotrophy, *Phytoplankton, *Rhone River, Carbon, Chlorophyll, Cycling nutrients, Light intensity, Nitrogen, Particulate matter, Plumes, Precipitation, Salinity, Turbidity, Water temperature.

Transfer processes from a eutrophic ecosystem, the river Rhone, to an oligotrophic environment, the northwest Mediterranean Sea, were studied during the winter period, when inputs of dissolved and particulate matter are at their highest. During a cruise carried out in February 1987, salinity, temperature, turbidity, nutrients, pigments, suspended particulate matter and particulate carbon and nitrogen were measured in surface and subsurface waters near the Rhone outlet. For most of the parameters the results show that during this period a simple dilution process occurs in the river plume of the Rhone without adsorption, desorption, precipitation or biological uptake, contrary to recordings for some other rivers. All the nutrients discharged into the sea by the Rhone are available for utilization by marine phytoplankters, and lead to renewal of production. This production can only occur in sea waters where salinity and light conditions are appropriate. (See also W91-11691) (Author's abstract)
W91-11692

INTERPRETATION OF THE SEASONAL VARIATIONS OF NUTRIENTS IN A MEDITERRANEAN LAGOON: ETANG DE THAU.
Departement Sciences de l'Environnement et Sante Publique URA CNRS 1355, Faculte de Pharmacie Av., Charles Flahault, 34060 Montpelier, France.
B. Picot, G. Pena, C. Casellas, D. Bondon, and J. Bontoux.
Hydrobiologia HYDRB8, Vol. 207, p 105-114, November 22, 1990. 5 fig, 2 tab, 34 ref.

Descriptors: *France, *Lagoons, *Limiting nutrients, *Mediterranean Sea, *Nitrogen, *Phosphorus, *Phytoplankton, Ammonium, Cycling nutrients, Mariculture, Mollusks, Nutrient concentrations, Organic matter, Seasonal variation, Thau Lagoon, Watersheds.

A network of 63 stations was used on four occasions (June 1986, October 1986, February 1987, and May 1987) to study the spatio-temporal distribution of inorganic nutrients in Thau Lagoon (l'etang de Thau), which covers 7500 hectares on the French Mediterranean coast. Three environmental factors, revealed by multiple regression models, govern the distributions observed. Allochthonous inputs from the watershed enrich the environment with nitrogen and phosphorus compounds in the winter and autumn. Internal sources are essentially localized in the shellfish breeding zone of the lagoon. In the summer, shellfish excretions and the rapid remineralization of organic deposits produce ammonium ions. Uptake by phytoplankton has a much larger impact on the seasonal variation of inorganic nitrogen than on that of phosphorus; phosphorus is present in excess in the lagoon waters. Thus, nitrogen appears to be the primary limiting nutrient for the development of the chlorophyllous biomass. Oysters are bred throughout the year in the same area of Thau Lagoon, producing a certain accumulation of nitrogen in the sediments. The productivity of the lagoon is thus related to this accumulated sedimentation, which provides an ammonium source for a limited period. (Brunone-PTT)
W91-11693

EFFECTS OF OXYGEN ON DENITRIFICATION IN MARINE SEDIMENTS.
Centre d'Oceanologie de Marseille (France).
P. Bonin, and N. Raymond.
Hydrobiologia HYDRB8, Vol. 207, p 115-122, November 22, 1990. 6 fig, 1 tab, 23 ref.

Descriptors: *Bacterial physiology, *Denitrification, *Marine environment, *Oxygen demand, *Sediment chemistry, Aerobic conditions, Anoxic conditions, Nitrates, Nitrites, Nitrogen cycle, Nitrogen oxides.

Experiments were carried out to determine the effect of oxygen on denitrification, simultaneously in sediment and in a bacterial strain isolated from this sediment. In sediment, denitrification was found to occur when the oxygen concentration increased to 5 mg/L, but the activity was only 10% of that obtained under anaerobic conditions. The two first steps of denitrification measured in the sediments were less sensitive to oxygen. When the sediment was incubated in the presence of 1.1 mg/LO2, the denitrification rate was never fully restored by return to anaerobic conditions. In cell suspensions of the denitrifying bacteria, Pseudomonas nautica isolated from the sediment, denitrification was equally strongly influenced by oxygen. The different steps of denitrification, nitrate, nitrite, and nitrous oxide reduction, were differently affected with respect to oxygen concentration. The nitrate reduction was less sensitive than nitrite and nitrous oxide reduction. (Author's abstract)
W91-11694

OXYGEN PROFILES IN INTERTIDAL SEDIMENTS OF RIA FORMOSA (S. PORTUGAL).
Lisbon Univ. (Portugal). Dept. de Biologia Vegetal.
V. Brotas, A. Amorim-Ferreira, C. Vale, and F. Catarino.
Hydrobiologia HYDRB8, Vol. 207, p 123-129, November 22, 1990. 6 fig, 1 tab, 12 ref. JNICT Contract No. 869.86.141.

Descriptors: *Coastal lagoons, *Intertidal areas, *Oxygen requirements, *Portugal, *Ria Formosa, *Sediment chemistry, *Sediment-water interfaces, *Tidal effects, Aerobic conditions, Diurnal variation, Inundation, Tidal flats.

Microelectrode oxygen profiles were measured in intertidal sediments from Ria Formosa (south Portugal), a very productive shallow coastal lagoon. Four intertidal sampling sites were selected according to different sediment characteristics. Individual profiles revealed a high degree of lateral variability on a centimeter spatial scale. Nevertheless, consistent differences were observed between oxygen profiles measured in atmosphere-exposed and inundated intertidal sediments: in organically poor sand oxygen-penetration depth varied from 3 mm in inundated cores to more than 7 mm in exposed cores, while in organically rich muddy sand and mud, the oxygen-penetration depth remained between 0.5 to 2.0 mm. The oxygen input from inundated to exposed conditions was estimated for each sampling site. Semi-diurnal tidal fluctuation, leading to periodical atmospheric exposure of sediments plays a major role in the oxygenation process of intertidal zones of Ria Formosa. (Author's abstract)
W91-11695

STUDY OF THE RIA FORMOSA ECOSYSTEM: BENTHIC NUTRIENT REMINERALIZATION AND TIDAL VARIABILITY OF NUTRIENTS IN THE WATER.
Instituto Nacional de Investigacao das Pescas, Olhao (Portugal). Centro Regional de Investigacao Pesqueira.
M. Falcao, and C. Vale.
Hydrobiologia HYDRB8, Vol. 207, p 137-146, November 22, 1990. 6 fig, 1 tab, 17 ref.

Descriptors: *Cycling nutrients, *Estuarine environment, *Nutrient transport, *Portugal, *Ria Formosa, *Sediment-water interfaces, *Tidal effects, Coastal waters, Nitrates, Periodicity, Phosphates, Seasonal variation, Silicates, Tides, Vegetation.

Exchange of nutrients across the sediment-water interfaces of Ria Formosa was studied in the laboratory. In the field, water samples were collected (1) fortnightly, at low and high tide over one year, and (2) semi-diurnally, over three neap-spring tidal cycles in winter. Results from both laboratory experiments and field collection were quite variable. Higher liberation rates of silicates, phosphates, and ammonium occurred in chambers whose bottom was formed by mixtures of mud and sand covered by vegetation with clams. The bottom took up nitrates from the overlying water. Nutrient variations in the lagoon water were controlled both seasonally and tidally. Higher concentrations of silicates were found at low tide independently of the season; phosphates in spring/summer at low tide; nitrates in winter/spring at high tide. Tidal flushing appears to be an important removal mechanism in this lagoon. Therefore a feedback loop between Ria Formosa and coastal ocean water should take place. (Author's abstract)
W91-11697

DISTRIBUTION OF MICROAEROPHILIC BACTERIA THROUGH THE OXIC-ANOXIC TRANSITION ZONE OF LAGOON SEDIMENTS.
Centre Univ. de Luminy, Marseille (France).
M. J. Ferrara-Guerrero, and A. Bianchi.
Hydrobiologia HYDRB8, Vol. 207, p 147-152, November 22, 1990. 3 fig, 1 tab, 24 ref.

Descriptors: *Aquatic bacteria, *Coastal lagoons, *Marine sediments, *Mediterranean Sea, *Oxygen requirements, *Sediment chemistry, *Sediment-water interfaces, Aerobic conditions, Anaerobic conditions, Bioturbation, Decomposition, Organic matter, Population density, Sandy clay, Water circulation.

In marine sediments, where soluble gases diffuse only very slightly, many organisms struggle for molecular oxygen. Microaerophilic bacteria, able to grow at reduced pO2 between 0.2 and 12%, have an advantage. Distribution of aerobes, microaerophiles and anaerobes was compared with the oxygen gradient in seawater and sediment samples collected in a northern Mediterranean lagoon. In the near bottom seawater and in the 0 to 10 mm upper layer of sediment, the microaerophilic counts were less than 1% of aerobe densities. In the 10 to 15 mm zone, these two groups were equivalent in density (100,000 cells/ml). As expected, the microaerophiles took advantage of their low oxygen tension requirements in the subsurface sediments, between the well aerated zone (0 to 5 mm depth) and the low redox potential zone. Then, beyond a depth of 20 mm, the anaerobes prevailed in this sandy clay. The distribution of molecular oxygen in sediment rich in organic matter (5 to 7% organic carbon) could have several causes: (1) a result mainly of seagrass decomposition, which is refractory in nature; (2) the high porosity of the sandy clays facilitates both water and oxygen circulation; and (3) bioturbation processes due to diverse excavating polychaetes and crustaceans may induce a flow of oxygenated supernatant seawater down into the sediment. (Brunone-PTT)
W91-11698

IN SITU BIOCHEMICAL AND BACTERIAL VARIATION OF SEDIMENTS ENRICHED WITH MUSSEL BIODEPOSITS.
Centre d'Oceanologie de Marseille (France).
C. Grenz, M. N. Hermin, D. Baudinet, and R. Daumas.
Hydrobiologia HYDRB8, Vol. 207, p 153-160, November 22, 1990. 7 fig, 1 tab, 27 ref.

Descriptors: *Bacterial physiology, *Gulf of Fos, *Sea mussels, *Sediment chemistry, *Sediment-water interfaces, Bacterial growth, Biodegradation, Carbohydrates, Comparison studies, Enzymes, Organic matter, Sedimentation.

In order to estimate the qualitative variation of sedimented mussel deposits, biochemical and microbial measurements were taken following sediment enrichment with fresh feces and pseudofeces in a mussel farming area (Carteau, Gulf of Fos). During two months, cores samples were examined at three stations: one station enriched with mussel deposits, a second reference station without mussel deposits and occasionally a third continuously enriched sediment under a rope culture. Carbohydrates, organic carbon and nitrogen contents in the sediments indicated short-term variation after sedimentation. Bacterial production increased rapidly at the enriched station and returned to its initial level eight days later. At this station, exoglucosidase activity of bacteria, low at the beginning, reached a maximum two weeks after enrichment whereas exoproteolytic activity, which was high in the biodeposits, decreased in the course of the first week. These exoenzymatic activities were significantly higher at the enriched station than at the reference stations. Carbohydrate measurements were in agreement with these results. Sediment enrichment with mussel biodeposits induced a strong bacteria reaction at the sediment-water interface. Initial degradation steps are of particular importance when evaluating the rapid recycling of the labile fraction of organic matter in such an ecosystem. (Brunone-PTT)
W91-11699

POREWATER CHEMISTRY OF INORGANIC NITROGEN COMPOUNDS IN THE EASTERN SKAGERRAK (NE NORTH SEA).
Hamburg Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.
M. Wilken, K. K. Anton, and G. Liebezeit.
Hydrobiologia HYDRB8, Vol. 207, p 179-186, November 22, 1990. 6 fig, 28 ref. Bundesministerium fur Forschung und Technologie Grant MFU 05438.

Descriptors: *Cores, *Interstitial water, *Nitrogen, *North Sea, *Sediments, *Skagerrak, *Water chemistry, Biodegradation, Bottom topography, Nitrates, Nitrites, Nutrient concentrations, Organic matter, Particle size, Porosity, Sedimentation, Spatial variation.

With the exception of a few isolated areas in the German Bight and the central North Sea, the Skagerrak is the main area for deposition of particulate material in the North Sea Basin. Porosity, Eh and interstitial nitrogen compound profiles are given for four locations in the eastern Skagerrak. Sediments down to 30 cm depth, i.e. postindustrial in age, were analyzed. Porosity generally showed the expected exponential decrease reflecting sediment consolidation. Superimposed on this trend are deviations caused by bioturbation and changes in grain size composition. Nitrate/nitrite concentrations decrease with depth in all four cores. The results together with a detailed age determination (lead-210) suggest a high degree of both lateral and vertical variability as a result of local bottom topography and currents as well as event-controlled sedimentation processes. The degradability of organic matter appears to control porewater nutrient chemistry. (Brunone-PTT)
W91-11702

INCIDENCE OF MUSSEL CULTURE ON BIOGEOCHEMICAL FLUXES AT THE SEDIMENT-WATER INTERFACE.
Centre d'Oceanologie de Marseille (France).
D. Baudinet, E. Alliot, B. Berland, C. Grenz, and M. R. Plante-Cuny.
Hydrobiologia HYDRB8, Vol. 207, p 187-196, November 22, 1990. 4 fig, 3 tab, 41 ref.

Descriptors: *Cycling nutrients, *France, *Mariculture, *Nutrient concentrations, *Sea mussels, *Sediment-water interfaces, Biodeposition, Excretion, Gulf of Fos, Mollusks, Organic matter, Phosphates, Photosynthesis, Respiration, Seasonal variation, Sedimentation, Silicates, Water column.

Upward nutrient fluxes at the sediment-water interfaces were studied in a mussel farming zone (Carteau, Gulf of Fos, France) in order to estimate the impact of organic matter input from biodeposition. Nitrate, nitrite, ammonia, silicate, phosphate and oxygen were measured. Fluxes were estimated by means of polyacrylate benthic chambers placed at sites located under (UM) and outside (OM) the rope hanging structures. Transformation of biodeposited organic matter increases phosphate, silicate, and ammonia fluxes. No variation in nitrite fluxes could be detected and only minor differences were observed in nitrate and the oxygen production/consumption equilibrium at the two stations. Phosphate and silicate fluxes, which were always higher at the UM than at the OM sites, decreased from spring to winter. Ammonia fluxes were very high under mussel cultures in May and September and lower in November. The fact that ammonia flux was always higher at the UM than at the OM sites might be explained by degradation of mussel biodeposit, as well as by benthic macrofauna excretion. Discrepancies between fluxes of the nutrients studied at the UM and OM sites increased as organic particulate matter in the water column decreased. Variations of oxygen flux followed a different pattern, since they were correlated with presence and abundance of photosynthetic microphytes on the bottom and in the water. Bottom respiration exceeded production of oxygen only in May 1988 at the UM station. Biodeposit input into the sediment under mussel ropes does not affect the ecosystem, although the flow of nutrients towards the water column is higher than in other areas. (Author's abstract)
W91-11703

METAL EXCHANGES IN THE FAUNA-SEDIMENT SYSTEM: THE CASE OF NEREIS DIVERSICOLOR AND SCROBICULARIA PLANA IN THE BOU REGREG ESTUARY (MOROCCO).
Cadi Ayyad Univ., Marrakech (Morocco). Dept. de Biologie.
For primary bibliographic entry see Field 5B.
W91-11705

DYNAMICS OF CARBON ASSIMILATION BY ST. LAWRENCE ESTUARY PHYTOPLANKTON AT THE END OF SUMMER.
Laboratoire Arago, Banyuls-sur-Mer (France).
C. Descolas-Gros, and M. R. Fontugne.
Hydrobiologia HYDRB8, Vol. 207, p 227-232, November 22, 1990. 4 fig, 26 ref.

Descriptors: *Carbon cycle, *Estuaries, *Estuarine environment, *Phytoplankton, *St Lawrence Estuary, Assimilation, Assimilative capacity, Carbohy-

drates, Carbon dioxide, Enzymes, Light intensity, Organic carbon, Seasonal distribution, Turnover time.

In situ measurements of inorganic carbon assimilation by phytoplankton communities were taken in the St. Lawrence estuary during the end of summer 1982. Carboxylase activity measurements (ribulose-1,5-biphosphate carboxylase, beta carboxylases) and the carbon-13/carbon-12 ratio of phytoplankton organic carbon, expressed as delta carbon-13, were used to study patterns of assimilation. Upper estuary phytoplankton communities showed a smaller turnover rate in carbon assimilation in the lower estuary phytoplankton communities. Carbon assimilation was limited by light intensity in the upper estuary and by carbon dioxide availability in the lower estuary. In the St. Lawrence estuary, stable carbon isotope ratios of phytoplankton organic carbon seemed to be controlled by inorganic carbon availability rather than by phytoplankton metabolism. (Author's abstract)
W91-11707

ZOOPLANKTON FEEDING ON SESTON IN THE RHONE RIVER PLUME AREA (NW MEDITERRANEAN SEA) IN MAY 1988.
Centre d'Oceanologie de Marseille (France).
R. Gaudy, M. Pagano, and F. Lochet.
Hydrobiologia HYDRB8, Vol. 207, p 241-249, November 22, 1990. 4 fig, 3 tab, 35 ref.

Descriptors: *Deltas, *France, *Mediterranean Sea, *Plumes, *Rhone River, *Seston, *Zooplankton, Biomass, Food chains, Marine environment, Nutrient concentrations, Particle size, Particulate matter, Salinity, Species composition.

In the Rhone delta area, the seston concentration was maximum in the plume waters where small-sized particles dominated, while marine waters were characterized by larger particles. The food conditions were optimal for grazers in the interface layer, where the high chlorophyll concentration contrasted with the low values found under the plume. The mesozooplankton specific composition did not show marked differences in and outside the plume. No special pattern for particle size selection by grazers appeared in the plume, contrary to marine waters, where the largest particles were the most intensively grazed. The calculations of specific ingestion and filtration rates show that the plume waters (particularly at the salinity interface) were more favorable to zooplankton feeding than the marine ones (outside and under the plume). Nevertheless, taking into account the high level of seston biomass in the whole area studied, the daily grazing pressure of mesozooplankton was very low. Although no enhancement of zooplankton biomass was observed in the Rhone River plume waters in May 1988, this zone appeared to be the most favorable for zooplankton algal food acquisition and filtering activity. (Author's abstract)
W91-11709

EFFECTS OF BIOTURBATION ON PARTICLE REDISTRIBUTION IN MEDITERRANEAN COASTAL SEDIMENT: PRELIMINARY RESULTS.
Centre d'Oceanologie de Marseille (France).
M. Gerino.
Hydrobiologia HYDRB8, Vol. 207, p 251-258, November 22, 1990. 4 fig, 1 tab, 29 ref.

Descriptors: *Bioturbation, *Mediterranean Sea, *Particulate matter, *Sediment distribution, *Sediment-water interfaces, Animal behavior, Coasts, Mixing, Particle size, Polychaetes, Population density.

In order to quantify bioturbation processes in a coastal Mediterranean ecosystem, experiments were performed to determine sediment mixing rates, essential for understanding the movement of fecal pellets and organic matter across the sediment-water interface, resulting from macrobenthos activity. Particle flux was measured in situ for 22 days using luminophores, which are colored sediment particles with sizes ranging from 10 to 200 microm. In sediment depths from 0 to 5 cm, particle mixing was intensive due to high macrobenthos abundance. A small quantity of luminophores was transported down to a depth of 14 (+/-) 2 cm, where the macrofauna was represented principally by polychaetes. In a control experimental structural, without benthic fauna, no transfer of luminophores into the sediment was recorded. Sediment particle mixing measured in the ecosystem studied is intensive, and is the result of high macrobenthos activity. Different mixing modes occur with scales and rates depending on the organisms present. The luminophore profile resulting from bioturbation processes is explained by an intensive bioadvection sediment mixing added to a biodiffusive mixing with an order of magnitude of .000001 sq cm/sec. Tracer accumulations between 1 and 2 (+/-) 1 cm and between 4 and 5 (+/-) 1 cm are attributed to bioadvection activity of two or more distinct populations. Studies over a larger time scale have been undertaken to monitor developments in the observed subsurface maxima. The intensity of the measured particle flux indicates that bioturbation generates major changes in the initial structure and composition of the sediment-water interface. (Brunone-PTT)
W91-11710

ORGANIC MATTER DISTRIBUTION IN BURROWS OF THE THALASSINID CRUSTACEAN CALLICHIRUS LAURAE, GULF OF AQABA (RED SEA).
Nice Univ. (France). Groupe de Recherches de Sedimentologie et Geochronologie Marines.
J. de Vaugelas, and R. Buscail.
Hydrobiologia HYDRB8, Vol. 207, p 269-277, November 22, 1990. 4 fig, 1 tab, 38 ref.

Descriptors: *Fulvic acids, *Gulf of Aqaba, *Habitats, *Humic acids, *Humus, *Organic carbon, *Organic matter, *Red Sea, *Sediment chemistry, *Shrimp, Burrows, Nutrient concentrations, Sampling.

Analysis of sediments in and around the large and deep burrows made by the callinassid shrimp Callichirus laurae, Jordan Gulf of Aqaba (Red Sea), showed that organic carbon (OC), humic matter (HM), humic (HA), and fulvic acids (FA) are redistributed both quantitatively and qualitatively by sediment reworking activities. OC and HM concentrations are approximately 30 times higher in stomach contents than in surface sand, proving selective food uptake. An 11 to 17 times increase in OC and HM is observed in the mucus-rich burrow wall when compared to ambient sediment. Among humic substances, FA seem preferentially adsorbed by the shrimp, while HA are concentrated in the fecal pellets. The spatial distribution of organic matter is in the form of a three-dimensional network of burrow walls and organic accumulation in back-filled tunnels. Due to inadequate sampling gear and the three-dimensional nature of the distribution, organically rich networks, such as those of thalassinid shrimp are rarely considered in conventional sampling strategies, leading to an underestimation of the sediment organic content. (Author's abstract)
W91-11712

DIRECT MEASUREMENT OF NANOMOLAR NITRATE UPTAKE BY THE MARINE DIATOM PHAEODACTYLUM TRICORNUTUM (BOHLIN): IMPLICATIONS FOR STUDIES OF OLIGOTROPHIC ECOSYSTEMS.
Centre d'Oceanologie de Marseille (France).
P. Raimbault, G. Slawyk, and V. Gentilhomme.
Hydrobiologia HYDRB8, Vol. 207, p 311-318, November 22, 1990. 4 fig, 1 tab, 23 ref.

Descriptors: *Diatoms, *Marine algae, *Nitrates, *Nutrient concentrations, *Nutrient transport, *Oligotrophy, Algal growth, Limiting nutrients, Mathematical models, Model studies, Phytoplankton, Population density, Pulsing.

A new automated procedure for nanomolar nitrate analysis was applied to the study of uptake of low nitrate concentrations (<100 ngat/L) by phytoplankton. The precision of this analytical method (+/-3 ngat/L) made possible the monitoring of absorption of very low quantities of nitrate over short-term periods by a low cell density culture of the marine diatom Phaeodactylum tricornutum, where the levels of particulate nitrogen and chlorophyll were equivalent to those found in oligotrophic areas (0.5 microgat N/L and 0.4 microg/L respectively). By continuous monitoring of nitrate disappearance from the culture medium, the transient uptake responses of the diatom are accurately recorded after a spike addition of trace quantities of nitrate. New information is thereby provided on the still largely unknown small-scale phenomenon of pulsed nitrate supply in the upper layer of stratified oceans and the rapid uptake of these nitrate patches by phytoplankton. These results show that a nitrogen-limited culture of Phaeodactylum tricornutum is immediately capable of taking up trace quantities of nitrate (<100 ngat/L) at high rates (0.10 to 0.14/hour). These initial rates are one order of magnitude higher than the theoretical rates calculated from the Michaelis-Menten equation and are close to the level of maximum uptake rate (Vmax) (0.15/hour) obtained when cells are exposed to saturating nitrate concentrations. This rapid initial uptake would be a considerable advantage in oligotrophic areas where nanomolar nitrate supply is thought to be episodic. The results suggest that phytoplankton evolve adaptations to utilize the available nitrate at the spatial and temporal scales at which the nitrate occurs. This physiological adaptation is evidence of nitrate pulses in the field which would invalidate the steady-state approach to the oligotrophic ecosystems. (Author's abstract)
W91-11717

MEASUREMENT OF THE LONGITUDINAL DISPERSION COEFFICIENT NEAR A JUNCTION IN A TIDAL RIVER.
Queensland Univ., Brisbane (Australia). Dept. of Physics.
For primary bibliographic entry see Field 2E.
W91-11737

GROUND WATER IN THE ALEXANDRIA DUNE FIELD AND ITS POTENTIAL INFLUENCE ON THE ADJACENT SURF-ZONE.
Port Elizabeth Univ. (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 2F.
W91-11771

PROBLEMS OF SILTING IN MOROCCAN PORT ON THE ATLANTIC SIDE: THE SEDIMENTOLOGICAL IMPACT ON THE COAST (PROBLEMES D'ENSABLEMENT DES PORT MAROCAINS SUR LA FACADE ATLANTIQUE. LEUR IMPACT SEDIMENTOLOGIQUE SUR LE LITTORAL).
Paris-11 Univ., Orsay (France).
For primary bibliographic entry see Field 8B.
W91-11791

MARINE AND ESTUARINE PROTECTED AREAS IN TASMANIA, AUSTRALIA: THE COMPLEXITIES OF POLICY DEVELOPMENT.
Tasmania Univ., Hobart (Australia). Environmental Studies.
For primary bibliographic entry see Field 6E.
W91-11799

APPLICATION OF 210-PB-METHOD TO SHALLOW WATER ENVIRONMENTS, (IN CHINESE).
East China Normal Univ., Shanghai. Inst. of Estuarine and Coastal Research.
For primary bibliographic entry see Field 2J.
W91-11800

CHROMIUM BEHAVIOUR IN THE CHANGJIANG RIVER ESTUARY AND ITS ADJACENT SEA AREA, (IN CHINESE).
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 5B.
W91-11801

WETLAND PROTECTION IN SUPERFUND REMEDIATIONS.
Wisconsin Univ.-Madison. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5G.
W91-11831

SOURCES AND AREAL DISTRIBUTION OF TRACE METALS IN RECENT SEDIMENTS OF MIDDLE LOCH, PEARL HARBOR (HAWAII).
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W91-11849

PHOSPHORUS LOADS FROM SELECTED WATERSHEDS IN THE DRAINAGE AREA OF THE NORTHERN ADRIATIC SEA.
Milan Univ. (Italy). Inst. of Agricultural Entomology.
For primary bibliographic entry see Field 5B.
W91-12004

CHANGES IN THE PHYSIOLOGICAL PERFORMANCE AND ENERGY METABOLISM OF AN ESTUARINE MYSIDE (MYSIDOPSIS BAHIA) EXPOSED IN THE LABORATORY THROUGH A COMPLETE LIFE CYCLE TO THE DEFOLIANT DEF.
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W91-12020

PROTECTING BIODIVERSITY IN COASTAL ENVIRONMENTS: INTRODUCTION AND OVERVIEW.
Virginia Univ., Charlottesville. Div. of Urban and Environmental Planning.
T. Beatley.
Coastal Management CZMJBF, Vol. 19, No. 1, p 1-19, January/March 1991. 1 fig, 1 tab, 45 ref.

Descriptors: *Coastal environment, *Ecological effects, *Environmental protection, *Regulations, *Resources management, *Species diversity, *Water pollution effects, Air pollution, Land use, Legislation, Political aspects, Public policy.

Much less attention has been paid in recent years to the threats to coastal and marine biodiversity, compared to biodiversity in more terrestrial habitats. The tremendous biodiversity at risk and the severity and magnitude of the pressures being exerted on coastal habitats suggest the need for much greater attention to be focused here by both the policy and scientific communities. The threats to coastal biodiversity are numerous and include air and water pollution; over exploitation and harvesting; the introduction of exotic species; the dramatic loss of habitat due to urbanization, agricultural expansion, and other land use changes; and the potentially serious effects of global climate change. These threats suggest the need for swift action at a number of jurisdictional and governmental levels. Major components of such an effort are identified and described. These include the need for comprehensive management approaches, the expansion of parks and protected areas, restoration and mitigation, multinational and international initiatives, and efforts to promote sustainable development and sustainable lifestyles. Suggestions for future research are also provided. (Author's abstract)
W91-12023

RECOVERY STRATEGIES FOR PIPING PLOVERS IN MANAGED COASTAL LANDSCAPES.
Massachusetts Div. of Fisheries and Wildlife, Westborough. Natural Heritage and Endangered Species Program.
For primary bibliographic entry see Field 6G.
W91-12024

CHALLENGE OF PROTECTING ENDANGERED SPECIES HABITAT ALONG THE SOUTHERN CALIFORNIA COAST.
San Diego State Univ., CA.
For primary bibliographic entry see Field 5G.
W91-12025

VERTICAL MIGRATION OF A FLAGELLATE-DOMINATED BLOOM IN A SHALLOW SOUTH AFRICAN ESTUARY.
Port Elizabeth Univ. (South Africa). Dept. of Botany.
T. Hilmer, and G. C. Bate.
Botanica Marina BOTNA7, Vol. 34, No. 2, p 113-121, March 1991. 5 fig, 3 tab, 23 ref.

Descriptors: *Algal blooms, *Estuarine environment, *Eutrophication, *Flagellates, *Migration, Chlorophyll a, Dinoflagellates, Estuaries, Halocline, Phototropism, Phytoplankton, Recreation, Red tide, Shellfish farming, South Africa, Stratification, Sundays Estuary, Water column.

A bloom dominated by the dinoflagellate Katodinium rotundatum and the prasinophyte Micromonas pusilla was observed over a 24-hour period in the shallow upper reaches of the Sundays River estuary, South Africa. Samples were taken for routine cell counting and were monitored for phytoplankton chlorophyll a distribution. The bloom was displaced horizontally by the tides and displayed vertical migration, believed to be primarily due to K. rotundatum, with data for M. pusilla being inconclusive. The phasing of vertical migration with the ebb flood 2-layer flow in the stratified water column retained the bloom within the upper estuary. The strong halocline posed no barrier to the migration of K. rotundatum, while calculations based on the swimming velocity of M. pusilla show it to have only been capable of moving into the halocline and not through it. Phototaxis did not appear to be involved in the migration phenomenon, as the return to the surface was initiated 3 hours before sunrise. Red tide blooms of the raphidophyte Heterosigma akashiwo have also been noted in the Sundays River estuary. The identification of at least two red tide flagellates in this estuary necessitates further urgent investigations into their occurrence and mechanisms of bloom formation in other systems. It is also important to establish their possible future effects on recreational activities and emergent shellfish industries along the coast. (Doria-PTT)
W91-12041

PARTICULATE METALS IN FIVE MAJOR NORTH SEA ESTUARIES.
Plymouth Polytechnic (England). Inst. of Marine Studies.
For primary bibliographic entry see Field 5B.
W91-12044

SOME OBSERVATIONS ON THE EFFECT OF VERTICAL DENSITY GRADIENTS ON ESTUARINE TURBULENT TRANSPORT PROCESSES.
Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, K. O. K. Oduyemi, and K. Shiono.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No.4, p 365-383, April 1991. 9 fig, 19 ref.
NERC Research Grant GST/02/049.

Descriptors: *Density, *Estuaries, *Sediment transport, *Suspended solids, *Tamar Estuary, *Tidal hydraulics, *Turbulent flow, *Unsteady flow, Mixing, Salinity, Vertical distribution.

Measurements of the turbulent fluctuations of the vertical and horizontal components of velocity, salinity, and suspended solids concentration were made near to the limit of salinity intrusion in a moderately high tidal range estuary (Tamar estuary near Cotehele). Velocity and salinity were monitored at four points up to 3 m above the bed and suspended solids concentration was monitored at 0.5 m above the bed. The data show that the vertical gradients created by solutes and particulate matter affect the velocity turbulence field and hence modify the turbulent mean velocity field. Turbulent fluctuations can be generated either internally or at the bed. The velocity turbulence field was found to be dependent on relative depth, local gradient Richardson number, and acceleration effects. The scalar turbulence fields were found to depend on at least relative depth, the vertical component of the turbulent velocity fluctuations, and the relevant scalar gradient. The mixing length functions used to quantify the turbulent transport processes are shown to depend on the local gradient Richardson number. The combined observation of salinity and particulate concentration turbulent perturbations is shown to be important, as there is considerable interaction between them. It is clear that further study is required, which should be based on data with better spatial resolution. (Author's abstract)
W91-12045

RADIONUCLIDE DISTRIBUTIONS IN SEAWATER AROUND THE SELLAFIELD PIPELINE.
AEA Technology, Harwell (England). Energy and Environment.
For primary bibliographic entry see Field 5B.
W91-12046

CARBON ISOTOPE GEOCHEMISTRY OF THE CHANGJIANG ESTUARY.
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
For primary bibliographic entry see Field 2K.
W91-12047

STUDY OF THE ECOLOGICAL FUNCTIONING OF THE MAHAKAM DELTA (EAST KALIMANTAN, INDONESIA).
IARE, Domaine de Lavalette, 1037 rue J. F. Breton, 34090 Montpellier, France.
E. Dutrieux.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No.4, p 415-420, April 1991. 2 fig, 23 ref.

Descriptors: *Borneo, *Deltas, *Mangrove swamps, *Wetlands, Basins, Biomass, Drainage area, Ecological distribution, Ecology, Freshwater, Marine biology, Nutrients, Organic matter, Physical properties, River mouth, Seawater, Sediment transport, Sediments, Species diversity, Stream biota, Tides.

An ecological inventory was carried out between 1985 and 1988 on the Mahakam delta, located on the east coast of Kalimantan in Borneo (Indonesia). The delta is subject to two physical constraints. The first relates to the influx of freshwater from the river; the Mahakam is a gigantic drainage basin transporting large quantities of sediment. The other constraint is the cyclic influx of seawater at high tides, providing favorable physical and chemical conditions for the development of marine life. Four zones can be defined. In the freshwater apex zone, land-origin populations are well developed and benefit from continental organic inputs, while marine populations are practically nonexistent. The middle distributory zone is marked by low diversity and biomass. Salinity is too high to allow continental-origin species to develop, but is not stable enough for marine life. Nutrients do not appear to be a limiting factor. In the river mouth zone, the sea is the dominant influence. The relatively constant physical-chemical conditions and high nutrient supply favors the development of high diversity and biomass. In the central nondistributary zone, the fauna and flora are particularly poor, possibly because of low nutrient supply. Like other mangrove forests, the delta transforms organic and inorganic nutrients from land ecosystems into dissolved and particulate organic matter that can be used by marine ecosystems, thereby increasing the productivity of marine zones. (Doria-PTT)
W91-12048

BLY CREEK ECOSYSTEM STUDY: PHOSPHORUS TRANSPORT WITHIN A EUHALINE SALT MARSH BASIN, NORTH INLET, SOUTH CAROLINA.
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
R. F. Dame, T. G. Wolaver, T. M. Williams, J. D. Spurrier, and A. B. Miller.
Netherlands Journal of Sea Research NJSRBA, Vol. 27, No. 1, p 73-80, December 1990. 3 fig, 1

tab, 39 ref.

Descriptors: *Estuaries, *Nutrient transport, *Phosphorus, *Salt marshes, *South Carolina, *Tidal marshes, *Wetlands, Bly Creek, Ecosystems, Marine sediments, North Inlet, Oysters, Phosphates.

Phosphorus transport through the tidal creek linking the Bly Creek basin (North Inlet, South Carolina) and the surrounding water body was studied on 34 tidal cycles between 20 June 1983 and 19 June 1984. Annual estimates of phosphorus input to the basin via streamwater, groundwater, and rainwater were made. Inputs of PO4 into the basin via streamwater, groundwater, and rain totalled 19.6 kg P/yr; PO4 export from the basin was not significant. Within the basin, the salt marsh was shown to be an important sink for PO4 (207 kg P/yr) while the oyster reef community exported a statistically insignificant 7.7 kg P/yr. The data suggest that the source of the PO4 to the salt marsh is the water column or benthic sediments of the tidal creek. The salt marsh was a significant sink for particulate phosphorus, but those uptakes were less than the error on the insignificant fluxes into the basin via the water column. The oyster reef community was a statistically significant sink for total phosphorus (98 kg P/yr). (Author's abstract)
W91-12067

TROPHIC RELATIONSHIPS IN TIDAL FLAT AREAS: TO WHAT EXTENT ARE TIDAL FLATS DEPENDENT ON IMPORTED FOOD.
Biologische Anstalt Helgoland (Germany, F.R.)
H. Asmus, and R. M. Asmus.
Netherlands Journal of Sea Research NJSRBA, Vol. 27, No. 1, p 93-99, December 1990. 4 fig, 2 tab, 26 ref. Deutsche Forschungsgemeinschaft Grant As 49/1-1 Re 425/6-1.

Descriptors: *Benthos, *Ecosystems, *Intertidal areas, *Marine environment, *North Sea, *Nutrients, *Productivity, *Tidal flats, Bays, Biomass, Food chains, Germany, Mussels, Species composition.

In four intertidal areas of Koenigshafen (island of Sylt, Germany), biomass and production of macrozoobenthos were measured monthly in 1980 and 1984. The areas were characterized by different macrofauna assemblages (Nereis-Corophium belt, seagrass bed, Arenicola flat and mussel bed). Biomass and production of macrofauna were partitioned with regard to food preference of single species as well as to the food availability within their habitat. In the Nereis-Corophium belt, seagrass bed and the arenicola flat, most of the secondary production of the macrofauna was formed by grazing animals. Secondary production of mussel beds was nearly 10 times higher than in the other three assemblages. The suspension feeder assemblage depended on planktonic food imported from outside the bay. Considering the secondary production of the total tidal flat area, suspension feeders dominated the other trophic groups, indicating a key position of this group relative to the other macrofaunal assemblages. Mussel beds regulate the seston input to other communities situated further landward. Because of this dominance of the suspension feeder group the energy and material flow of the total tidal flat is strongly dependent on the seston input from the coastal waters of the North Sea or from other parts of the Wadden Sea. (Author's abstract)
W91-12068

INCREASED ABUNDANCE AND GROWTH OF THE SUSPENSION-FEEDING BIVALVE CORBULA GIBBA IN A SHALLOW PART OF THE EUTROPHIC LIMFJORD, DENMARK.
National Environmental Research Inst., Charlottenlund (Denmark).
For primary bibliographic entry see Field 5A.
W91-12069

OCCURRENCE AND BEHAVIOUR OF SEVERAL GROUPS OF ORGANIC MICROPOLLUTANTS IN THE SCHELDT ESTUARY.
Utrecht Rijksuniversiteit (Netherlands). Inst. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W91-12071

CONTRIBUTION OF PICOPLANKTON TO PRIMARY PRODUCTION IN ESTUARINE, COASTAL AND EQUATORIAL WATERS OF BRAZIL.
Sao Paulo Univ. (Brazil). Inst. Oceanografico.
C. Teixeira, and S. A. Gaeta.
Hydrobiologia HYDRB8, Vol. 209, No. 2, p 117-122, February 1991. 1 fig, 2 tab, 14 ref.

Descriptors: *Brazil, *Coastal waters, *Plankton, *Primary productivity, *Tropical regions, Cananela, Estuaries, Picoplankton, Ubatuba.

Quantitative estimation of the picoplankton (body size < 1.0 micrometer) in tropical and subtropical marine environments of Brazil was undertaken. Data were obtained in three ecosystems: (1) equatorial oceanic waters (North Brazil), (2) tropical coastal waters (Ubatuba), and (3) subtropical estuarine waters (Cananela). The size fraction from 0.45 to 1.0 micrometer was responsible for 3-28% of 14C uptake in estuarine waters, 18.5-40.4% in coastal waters, and 6.7-100.0% in oceanic waters. These results establish the importance of picoplankton as primary producers in different marine environments in Brazilian waters. (Rochester-PTT)
W91-12093

PERTURBATIONS IN THE REPRODUCTION CYCLE OF SOME HARPACTICOID COPEPOD SPECIES FURTHER TO THE AMOCO CADIZ OIL SPILL.
Universite de Bretagne-Occidentale, Brest (France). Lab. d'Oceanographie Biologie.
For primary bibliographic entry see Field 5C.
W91-12098

IN SITU STUDY OF THE EFFECT OF OYSTER BIOMASS ON BENTHIC METABOLIC EXCHANGE RATES.
Museume National d'Histoire Naturelle, Paris (France). Lab. de Biologie des Invertebres Marins et de Malacologie.
R. Boucher-Rodoni, and G. Boucher.
Hydrobiologia HYDRB8, Vol. 206, No. 2, p 115-123, October 22, 1990. 3 fig, 3 tab, 34 ref. IFREMER GIS Aquaculture Grant 85/2510582.

Descriptors: *Ammonia, *Benthic environment, *Biomass, *Metabolism, *Oysters, Benthos, Ecosystems, Light effects, Nitrogen, Oxygen, Oxygen requirements, Sediment-water interfaces.

Oxygen consumption and dissolved nitrogen fluxes at the water-sediment interface of an oyster-bed were measured in situ using transparent enclosures inserted on undisturbed sediment. Experiments were performed in summer, under dark and light conditions, with various densities of the oyster Crassostrea gigas (0-150 animals/sq m). The influence of oyster biomass on oxygen and ammonia exchange rates was similar in both lighting conditions. Oxygen consumption increased with increasing biomass, though not at the level of prediction for the highest biomasses, suggesting a depressed respiration rate. Ammonia release never matched the rates predicted by adding sediment efflux to oyster excretion, when biomass exceeded 100 g DW/sq m. The coupling between oxygen consumption and ammonia release (O:N ratio) was thus influenced by oyster biomass. Stabilization of nitrogen release was related to enhanced nitrification in the presence of oyster and/or sediment uptake of ammonia against the molecular gradient. Urea release was erratic but appeared uninfluenced by oyster biomass. Fluxes of oxygen and of each nitrogen compound therefore displayed a specific response to modifications of the oyster biomass. Both the organisms and the sediment are involved in regulation processes of metabolic exchange rates at the water-sediment interface. (Author's abstract)
W91-12128

HORIZONTAL CIRCULATION OF THE EASTERN MEDITERRANEAN WATERS DURING WINTER AND SUMMER SEASONS.
Institute of Oceanography and Fisheries, Alexandria (Egypt).
M. A. Said.
Acta Adriatica AADRAY, Vol. 31, No. 1/2, p 5-21, 1990. 16 fig, 1 tab, 29 ref.

Descriptors: *Mediterranean Sea, *Seasonal variation, *Water currents, Aegean Sea, Flow velocity, Ionian Sea, Levantine Sea, Libyan Sea, Mixing.

The water circulation of the Eastern Mediterranean was computed using the dynamic method, with a reference level at 1000 db surface. The fulfillment calculations evidenced the considerable stability of the geostrophic water circulation in the eastern and central basins of the Mediterranean Sea. The most pronounced features of the geostrophic circulation during the winter and summer seasons were: the vast cyclonic gyre in the Levantine Sea, enveloping the southern part of the Aegean Sea; the cyclonic gyre in the Ionian Sea; and the anticyclonic gyre in the Libyan Sea near the Egyptian coast. The geostrophic current velocity varied between 5-10 cm/sec in the Libyan Sea, 15-25 cm/sec near the Egyptian coast, and between 35-40 cm/sec in the eastern part of the Levantine Sea. At the strait of Crete island, the geostrophic current velocity reached 15-30 cm/sec. The differences between the winter and summer surface current velocity in the eastern and central basins of the Mediterranean Sea were not particularly pronounced. (Author's abstract)
W91-12155

DISTRIBUTION OF ORGANIC CARBON, NITROGEN AND PHOSPHORUS IN THE RECENT SEDIMENTS OF THE MEDITERRANEAN CONTINENTAL SHELF OF EGYPT.
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. El Sabrouti, N. M. Dowidar, and A. A. El Sammak.
Acta Adriatica AADRAY, Vol. 31, No. 1/2, p 23-35, 1990. 7 fig, 3 tab, 30 ref.

Descriptors: *Continental shelf, *Marine sediments, *Nitrogen, *Nutrients, *Organic carbon, *Phosphorus, Coastal sediments, Distribution patterns, Egypt, Estuaries, Nile River.

The distribution of organic carbon, nitrogen and phosphorus was studied in sediment samples from the continental shelf of Egypt between El Agamy and El Arish. On average, the sediments contained 7.61 mg/gm C, 1.36 mg/gm N, and 0.0905 mg/gm P dry weight. The distribution and the close correlation between the three elements studied indicate their close association. The spatial distribution of the elements, the tendency of decreasing concentrations as the testing moved farther away from the Nile mouth and the lake's openings and the relative richness of the sediments in the cones in front of two major estuaries of the river, suggest that the Nile River and the drainage water from the Delta are the main source of these elements in the investigated area. (Author's abstract)
W91-12156

DISTRIBUTION OF NITROGEN AND PHOSPHORUS IN THE MEDITERRANEAN WATERS OFF THE NILE DELTA.
Alexandria Univ. (Egypt). Dept. of Oceanography.
N. M. Dowidar, and A. R. Abdel-Moati.
Acta Adriatica AADRAY, Vol. 31, No. 1/2, p 37-46, 1990. 3 fig, 3 tab, 7 ref.

Descriptors: *Distribution patterns, *Mediterranean Sea, *Nile Delta, *Nitrogen, *Nutrients, *Phosphorus, Continental shelf, Limiting nutrients, Phytoplankton, Water quality.

The distribution of dissolved inorganic nitrogen and phosphorus in the pelagic waters overlying the continental shelf off the Egyptian Mediterranean coast was studied during February 1986. The dissolved inorganic fraction of either nitrogen or phosphorus constitutes a smaller percentage of the total concentration. Reactive phosphorus consti-

tutes on the average about 5% of the total phosphorus in the whole area, and dissolved inorganic nitrogen constitutes, on the average, about 6% of the total nitrogen. However, the ratio of total N (TN): total P (TP) varied between 26 and 37 indicating that the total concentration of P in the area was comparatively lower than that of N. Hence, it is most probable that in the southeastern Mediterranean waters, phytoplankton growth is limited by P rather than N. One feature observed during the cruise was the comparatively high particulate P content relative to dissolved inorganic P (DIP) in the whole area which was probably due to adsorption of P ions on the fine particles suspended in the water during this season. As previously mentioned, the content of total suspended matter (TSM) was remarkably high, due mostly to the resuspension of bottom sediments and detritus caused by various active mixing processes appearing during this season. The average relative abundance of different components of TN and TP in the offshore water may be expressed as follows: NO3, 4.3%; NO2, 0.5%; NH3, 1.8%; dissolved organic nitrogen, 42%; total particulate N, 66.3%; and DIP, 3.0%; dissolved organic P, 35.4%; and particulate P, 62.4%. (Lantz-PTT)
W91-12157

T90 OF TOTAL COLIFORMS, FAECAL COLIFORMS AND FAECAL STREPTOCOCCI IN THE KASTELA BAY.
Institute of Oceanography and Fisheries, Split (Yugoslavia).
For primary bibliographic entry see Field 5B.
W91-12159

ZOOPLANKTON ASSEMBLAGES IN THE SHALLOW TIDAL ESTUARY OF MUNDAKA (BAY OF BISCAY).
Universidad del Pais Vasco, Bilbao (Spain). Lab. de Ecologia.
F. Villate.
Cahiers de Biologie Marine CBIMA5, Vol. 32, No. 1, p 105-119, 1991. 8 fig, 30 ref.

Descriptors: *Bay of Biscay, *Estuaries, *Estuarine environment, *Mundaka Estuary, *Zooplankton, Ecosystems, Mixing, Salinity, Seasonal variation, Tidal hydraulics.

Spatial and temporal variability of zooplankton assemblages were studied in the tidal estuary of Mundaka, from May 1981 to July 1982, in relation to factors controlling estuarine hydrodynamics. Salinity range and maintenance of mixed waters were related to the tidal amplitude and rainfall, which drives river discharge. At high tide, the study zone appeared to be a mainly polyhaline system, in which Acartia bifilosa was the only perennial component of the estuarine-marine assemblage, and true estuarine copepods (genus Eurytemora) were absent. Among neritic holoplankters, Parracalanus parvus and Acartia clausi dominated and no seasonally stable euryhaline and stenohaline assemblages were found. Among meroplankton groups, larvae of Polychaete Spionids was predominant toward the upper estuary, while Bivalve veligers had the lowest penetration in the estuary from the neritic zone. Some nectobenthic organisms associated with muddy benthic habitats, such as Praniza larvae of Paragnathia formica and ostracod Cytherids, characterized the plankton community of the upper estuary during periods of low abundance of estuarine holoplankton. According to the hierarchical clustering of samples from zooplankton data, summer-autumn, winter and spring periods were separated as seasonal units, which also differed with regard to hydrological features. The mixed water persistency and the development of estuarine species were higher in summer, when low freshwater inflows and neap tides coincided. By contrast, high-salinity waters and neritic zooplankton filled the estuary in spring by the effect of spring tides coupled with low freshwater inflows. (Author's abstract)
W91-12162

CONTINUOUS AUTOMATED SAMPLING OF TIDAL EXCHANGES OF NUTRIENTS BY BRACKISH MARSHES.
Smithsonian Environmental Research Center, Edgewater, MD.
T. E. Jordan, and D. L. Correll.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No. 6, p 527-545, June 1991. 9 fig, 3 tab, 47 ref. NSF Grants BSR-86-15902 and BSR-86-15902-01.

Descriptors: *Brackish water, *Nutrients, *Tidal hydraulics, *Wetlands, Ammonium, Automation, Comparison studies, Marshes, Measuring instruments, Nitrates, Nitrogen, Organic carbon, Organic phosphorus, Phosphates, Phosphorus, Tidal marshes, Water sampling.

Automated instruments were used to measure tidal exchanges of materials at two brackish marshes of differing elevation. The instruments, located at the mouths of the tidal creeks draining the marshes, measured depth and tidal current velocity, and pumped water samples in volumes proportional to flow. Separate composite samples of flood and ebb water were collected weekly for about two-thirds of the weeks throughout a 2-3 year period and analyzed for orthophosphate (PO4(3-)), total organic P (TOP), ammonium (NH4(+)), nitrate plus nitrite (NO3(-)), total organic N (TON), total organic C (TOC), and total suspended particles (TSP). Exchanges of these materials differed for the two marshes. At the lower elevation marsh, the largest net flux was an import of TON, but TON was exported by the high marsh. The low marsh also imported TOP, NO3(-), and TSP, but there were not significant exchanges of these materials at the high marsh. The largest net flux at the high marsh was an export of TOC, but there was no significant net exchange of TOC at the low marsh. Both marshes exported NH4(+). At the low marsh the tidal exchange of PO4(3-) and NH4(+) differed among years, with PO4(3-) exchange differing in direction as well as magnitude. In general, the high marsh was more prone to export materials, especially organic N and C, while the low marsh was more dominated by deposition and tended to import materials. Compared to manual techniques previously used to measure tidal exchanges, automated sampling permits lower cost observations of many more tidal cycles, including observations during episodic storms or extreme tides. Although strong effects of such episodic events were not detected by the weekly composite sampling used in this study, the inclusion of such events in the sampling probably increases the accuracy of estimates of average tidal exchanges. (Author's abstract)
W91-12167

ESTUARINE SALT CONSERVATION: A LAGRANGIAN APPROACH.
Washington Univ., Seattle. Geophysics Program.
D. A. Jay.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No. 6, p 547-565, June 1991. 1 fig, 47 ref, append. NSF Grant OCE-8711790.

Descriptors: *Estuaries, *Lagrangian model, *Mathematical models, *Salinity, *Salt balance, *Tidal hydraulics, Flow velocity, Mathematical studies, Salts, Tidal currents.

Understanding tidal and mean flow transport mechanisms that maintain the estuarine salt balance against seaward transport by river flow is one of the fundamental questions of estuarine oceanography. Previous salt transport studies have failed to resolve this problem for two principal methodological reasons, in addition to the inherent variability of estuaries. First, salt transport expansions used to represent the salt balance have included a large number of terms that could not be related to any theory of estuarine circulation and whose physical meaning was thus unclear. Second, it has proven difficult to measure small mean velocities in the presence of much larger tidal variations. A new analysis method that expresses Lagrangian scalar property transport in terms of time and space variations of Eulerian variables is much simpler than expansions previously used and yields new insights into estuarine transport processes. This approach (like previous expansions) is valid for narrow systems in which cross-channel transport processes are weak and the ratio of tidal amplitude to mean depth is small. A surface boundary condition was used to eliminate one class of troublesome terms. The equivalence of the tidal-cycle average transport of tidal variations in salinity and the Stokes transport of mean salinity was then employed to show that the vertically integrated tidal flow plays no role in the overall salt balance. That is, seaward transport of salt caused by the river flow can only be balanced by landward transport resulting from correlations between shear and stratification in the mean, tidal and over-tide flows. In a hypothetical inviscid estuary, tide and over-tide flows would be vertically uniform, and outward fluvial salt transport could only be balanced by shear and stratification in the mean gravitational circulation. In a more realistic example with strong friction, the gravitational circulation would be severely damped, and inward transport could only be accomplished by correlations of shear and stratification in the tide and over-tide flows. (Author's abstract)
W91-12168

BIRD COLONIES CAUSE SEAGRASS ENRICHMENT IN A SUBTROPICAL ESTUARY: OBSERVATIONAL AND EXPERIMENTAL EVIDENCE.
National Audubon Society, Tavernier, FL.
G. V. N. Powell, J. W. Fourqurean, W. J. Kenworthy, and J. C. Zieman.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No. 6, p 567-579, June 1991. 6 fig, 2 tab, 29 ref.

Descriptors: *Birds, *Ecosystems, *Estuaries, *Florida Bay, *Nutrients, *Sea grasses, Fish populations, Species composition.

Colonies/roosts of piscivorous birds in Florida Bay, a subtropical estuary, concentrate nutrients by feeding away from their colonies/roosts and returning with food for young and to defecate. Seagrass beds surrounding the colony islands were markedly different from those around similar islands that did not contain colonies. The seagrass standing crop was enhanced up to 200 m from bird colony islands compared with islands without colonies. Species of seagrass were also different at colonies, where Halodule wrightii and Ruppia maritima predominated in zones close to the colony islands. Around islands without colonies, only Thalassia testudinum was present. Experimental bird perches placed to stimulate concentrated bird presence produced changes in adjacent seagrass meadows that were similar to differences between islands with colonies and those without. Over 5 years, seagrass standing crop increased around the experimental perches, and species dominance shifted from T. testudinum to H. wrightii. No similar changes occurred at control locations. These experimental results indicate that the bird concentrations are responsible for the observed differences in seagrass communities surrounding islands that contain colonies. These enriched areas are significant to the seagrass ecosystem because many seagrasses in Florida Bay appear to be nutrient-limited. Demersal fish and invertebrate density and species richness have been shown to be a function of the seagrass standing crop and species composition, so the changes in seagrasses stimulated by localized bird concentrations have the capacity to alter the entire community structure. (Author's abstract)
W91-12169

FIELD STUDIES OF THE FLOW STRUCTURE IN A STRAIGHT REACH OF THE CONWY ESTUARY.
Sheffield Univ. (England). Dept. of Civil and Structural Engineering.
I. Guymer, and J. R. West.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No. 6, p 581-596, June 1991. 11 fig, 1 plate, 15 ref.

Descriptors: *Conwy Estuary, *Estuaries, *Flow pattern, *Tidal hydraulics, Dye releases, Field tests, Flow profiles, Flow velocity, Hydraulics, Salinity, Tracers, Wales, Water depth.

Synchronous measurements of dye distributions from a single-point source surface injection, and of the turbulent mean flow structure in a straight reach of the Conwy estuary, have been obtained for several tidal cycles. The resulting two-dimensional temporal (y,z,t) variations of velocity and salinity, together with the three-dimensional (x,y,z) dye distributions have been used to provide both a qualitative and quantitative description of the vertical stability and transverse flows caused by the interaction of the longitudinal solute-induced density gradient and fluid shear. The results show that the flow structure is temporally dependent due to velocity and depth changes and is spatially dependent due to channel topography. (Author's abstract)
W91-12170

EFFECT OF KINGSTON HARBOUR OUTFLOW ON THE ZOOPLANKTON POPULATIONS OF HELLSHIRE, SOUTH-EAST COAST, JAMAICA.
University of the West Indies, Kingston (Jamaica). Dept. of Zoology.
M. K. Lindo.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No. 6, p 597-608, June 1991. 4 fig, 3 tab, 31 ref.

Descriptors: *Ecosystems, *Jamaica, *Kingston Harbour, *Population dynamics, *Tidal hydraulics, *Zooplankton, Biomass, Copepods, Seasonal variation, Species composition.

Zooplankton sampling was conducted at 16 stations located at the mouth of Kingston Harbor and throughout the Hellshire area from November 1985 to March 1987. Parameters examined included total biomass, total numbers and numbers of numerically important zooplankton species. Maximum values were recorded west of the Harbor mouth (station 1) and these gradually decreased with distance from the Harbor especially at the 'offshore' stations, producing a gradient effect in this area. Mean biomass and abundance for the period sampled ranged from 16 gm/cu m and 16,313 individuals/cu m at the western side of the Harbor mouth to 0.4 g/cu m and 172 individuals/cu m at Wreck Reef. Stations within the bays of Hellshire occasionally had values similar to those recorded at the mouth of Kingston Harbor and here there was less evidence of a gradual decline. Considerable monthly fluctuation occurred in these parameters but there was no discernible seasonal pattern. Copepods dominated the population at most stations and the serrgestid Lucifer faxoni also proved an important member at the western Harbor mouth station. (Author's abstract)
W91-12171

SEASONAL PHYTOPLANKTON COMPOSITION, PRODUCTIVITY AND BIOMASS IN THE NEUSE RIVER ESTUARY, NORTH CAROLINA.
North Carolina Univ., Morehead City. Inst. of Marine Sciences.
For primary bibliographic entry see Field 2H.
W91-12172

MACROBENTHIC COMMUNITY STRUCTURE BEFORE AND AFTER POLLUTION ABATEMENT IN THE NECHES RIVER ESTUARY (TEXAS).
Lamar Univ., Beaumont, TX. Dept. of Biology.
For primary bibliographic entry see Field 5G.
W91-12193

FLOW DYNAMICS IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA.
Royal Roads Military Coll., Victoria (British Columbia). Dept. of Physics.
M. W. Stacey, S. Pond, and P. H. LeBlond.
Atmosphere - Ocean ATOCDA, Vol. 29, No. 1, p 1-13, March 1991. 5 fig, 2 tab, 11 ref. Natural Sciences and Engineering Research Council of Canada strategic grant A1108.

Descriptors: *Estuaries, *Strait of Georgia, *Straits, *Water currents, *Wind-driven currents, Barocline, Current meters, Horizontal distribution, Mathematical equations, Model studies, Vertical distribution.

The balance of forces responsible for the vertical structure of the mean currents in the Strait of Georgia was examined using data collected from an array of four cyclesonde (profiling current meter) and five Aanderaa current-meter moorings. Tests using the thermal wind equations showed that a geostrophic mean state was a reasonable approximation, although possibly some ageostrophic effects occurred. The evidence supported the existence of barotropic and baroclinic instabilities. A barotropic energy transfer rate at 100-m depth was found to correspond to an e-folding time for amplitudes of about 4 days. The eddy viscosity associated with the barotropic transfer was about 60 sq m/second. A statistically significant baroclinic rate was detectable at one of the four cyclesonde stations. The transfer rate associated with it was found to be about the same as that for the barotropic rate. A simple baroclinic instability model was modified to show that horizontal variations in the flow field in the Strait of Georgia could significantly suppress baroclinic instability. (Author's abstract)
W91-12251

FORTNIGHTLY MEAN CIRCULATION OF CHESAPEAKE BAY.
National Oceanic and Atmospheric Administration, Silver Spring, MD. Office of Global Programs.
D. M. Goodrich, and A. F. Blumberg.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No. 5, p 451-462, May 1991. 4 fig, 3 tab, 26 ref. U.S. Army Corps of Engineers Contract DACW39-88-D0035, Task Order 4.

Descriptors: *Bays, *Chesapeake Bay, *Estuaries, *Water circulation, *Water currents, Density stratification, Gravity flow, Runoff, Seasonal variation, Spatial distribution, Statistical analysis, Wind stress.

Data from several current measurement programs were used to examine the temporal and spatial variability of Chesapeake Bay circulation at time scales of 15 days and longer. First, year-long current records from two stations were analyzed for response to runoff, wind stress and gravitational forcing. A strong spring freshet in April resulted in an annual maximum in the longitudinal density gradient, yet the surface current at mid-bay actually declined at the time of this maximum. The reason for this response lies in a prolonged period of northward wind that effectively reduced the strength of the two-layer gravitational flow. This shows that seasonal changes in the wind field can modulate the gravitational flow and that these annual wind shifts are a significant factor in the circulation of this estuary. Statistical analysis also indicates correlation between surface current and longitudinal wind at time scales of 15 days and longer, implying that meteorological effects cannot be completely filtered out at these frequencies. These data demonstrate that Chesapeake Bay circulation, unlike runoff, does not change by orders of magnitude between seasons, indicating that an examination of spatial patterns of circulation can be made using data collected during different deployment periods. A total of 168 current records from 1977 to 1983, averaged over periods of at least 15 days, were used to examine the spatial structure of the mean bay-wide circulation. Surface velocity, while predominantly down-bay, shows considerable longitudinal structure. This is to be expected considering the different meteorological conditions under which the data was collected. However, bottom observations show remarkably coherent up-bay flow regardless of the measurement period, illustrating the dominant role of topography and the importance of the gravitational mode in bay circulation. (Author's abstract)
W91-12266

PHYTOPLANKTONIC SOURCES OF VOLATILE ALDEHYDES IN THE RIVER RHONE ESTUARY.
Laboratoire de Physique et Chimie Marines, Villefranche-sur-Mer (France).
For primary bibliographic entry see Field 2H.
W91-12267

INTERNAL WAVE ACTIVITY IN ROTTERDAM WATERWAY.
British Columbia Univ., Vancouver. Dept. of Oceanography.
For primary bibliographic entry see Field 8B.
W91-12359

NUMERICAL MODELLING OF TIDAL MOTION IN SINGAPORE STRAIT.
National Univ. of Singapore. Dept. of Civil Engineering.
H. F. Cheong, M. H. A. Khader, and C. J. Yang.
Journal of Hydraulic Research JHYRAF, Vol. 29, No. 2, p 229-242, 1991. 10 fig, 1 tab, 8 ref, append.

Descriptors: *Mathematical models, *Model studies, *Singapore Strait, *Tidal currents, *Tidal hydraulics, Chezy equation, Flow velocity, Hydrodynamics, Model testing, Simulation analysis, Tidal amplitude.

For long waves propagating in shallow water in which the water particle motion is nearly horizontal, the governing equations, in terms of depth integrated velocities, can be written as a Eulerian form of the Grubert hydrodynamic model. The stability of the Grubert scheme was examined by applying it to a one-dimensional flow problem--the Grubert model was modified to simulate tidal elevations and tide-induced velocities. This analysis showed that the scheme is 'stronger' in one direction, but after further modification, the scheme was unconditionally stable in both directions for one-dimensional flow situations. The two-dimensional model was used to simulate tidal motion in Singapore Strait for the period from August 5 to August 19, 1978. The simulation became stable after about two tidal cycles of simulation. Model calibration was done by adjusting the Chezy coefficient, which led to a negligible change in tidal elevations, and significant changes in current speeds and phases. Tidal amplitudes matched well for all stations but one. The matching of current speeds was variable but simulated current directions generally matched field data. No significant differences were noted in results between the Grubert scheme and modified Grubert scheme. (Doria-PTT)
W91-12370

ATTENUATION OF PHOTOSYNTHETICALLY-ACTIVE RADIATION IN SOME ESTUARINE WATERS OF THE NORTHWESTERN BLACK SEA (IN RUSSIAN).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. V. Siderskiy.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 26, No. 6, p 65-70, 1990. 2 fig, 1 tab, 3 ref. English summary.

Descriptors: *Black Sea, *Estuaries, *Light penetration, *Optical properties, Light intensity, Light quality, Lighting, Photosynthesis, Physical properties, Radiation, Solar radiation, USSR.

Hydrooptic characteristics of tidal zone waters in the Northwestern Black Sea were measured. Samples were divided into two groups based on the values of an integral index of vertical sunlight attenuation within the range of photosynthetic-active radiation. These measurements made it possible to estimate the naturally illumination properties of the water mass. (Mertz-PTT)
W91-12380

MULTI-YEAR DISTRIBUTION PATTERNS OF NUTRIENTS WITHIN THE NEUSE RIVER ESTUARY, NORTH CAROLINA.
East Carolina Univ., Greenville, NC. Dept. of Biology.
R. R. Christian, J. N. Boyer, and D. W. Stanley.
Marine Ecology Progress Series MESEDT, Vol. 71, No. 3, p 259-274, April 30, 1991. 10 fig, 3 tab, 52 ref. NOAAO Sea Grant NA85AA-D-SG022 and EPA Grant R-812475-01-0.

Descriptors: *Cycling nutrients, *Distribution patterns, *Estuaries, *Estuarine environment, *Estuarine sediments, *Neuse River, *North Carolina, *Nutrients, Ammonium, Chemical speciation, Chlorophyll, Nitrogen, Nutrient concentrations, Nutrient transport, Phosphorus, Spatial distribution, Temporal distribution, Water chemistry.

Spatial and temporal patterns of nutrient distributions of the Neuse River Estuary, North Carolina, were assessed from a 4-year study involving 82 longitudinal transects of the estuary. The major, river-dominated estuary receives water from a 16,000 sq km drainage basin and is connected to the Atlantic Ocean by Pamlico Sound. Concentrations of nitrogen and phosphorus species and chlorophyll a were measured in association with environmental factors. Intrastation distribution of variables were generally non-normal, and interstation distribution patterns varied considerably between species measured. Concentrations of dissolved species decreased down estuary, although internal sources of both ammonium and filterable reactive phosphorus were apparent. Particulate species demonstrated maxima in the upper estuary associated with autochthonous production. The relative isolation of the Neuse River Estuary from ocean inputs and long flushing times of freshwater provide an environment which promotes nonconservative mixing of nutrient species. The average flushing time for the estuary was 51 days, providing an extended period within the estuary for substantial recycling. Thus, distribution patterns reflect the dominance of biological and chemical activity except when large freshets cause rapid movement of water to the lower estuary and out into Pamlico Sound. (Author's abstract)
W91-12390

RESPONSE OF A MARINE SHALLOW-WATER SEDIMENT SYSTEM TO AN INCREASED LOAD OF INORGANIC NUTRIENTS.
Goeteborg Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-12391

TIDAL RESUSPENSION OF SEDIMENTS IN NORTHERN CHESAPEAKE BAY.
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 2J.
W91-12392

CYCLING OF NUTRIENT ELEMENTS IN THE NORTH SEA.
Hamburg Univ. (Germany, F.R.). Inst. fuer Biochemie und Lebensmittelschemie.
U. H. Brockmann, R. W. P. M. Laane, and H. Postma.
Netherlands Journal of Sea Research NJSRBA, Vol. 26, No. 2/4, p 239-264, November 1990. 19 fig, 2 tab, 118 ref.

Descriptors: *Cycling nutrients, *North Sea, *Nutrients, *Seasonal variation, *Upwelling, Ammonia, Biomass, Carbon, Chemical stratification, Coastal waters, Limiting nutrients, Literature review, Nitrogen, Phosphorus, Primary production, Silicates, Stratification, Thermal stratification.

Regional effects on nutrient cycling (carbon, nitrogen, phosphorus and silicate) in the North Sea, such as thermal and haline stratification, coastal interaction, river discharges, upwelling and frontal zones, were investigated for both spring 1986 and winter 1987. In winter, the highest nutrient concentrations were found at the northern boundary in the Atlantic inflow, and in the continental coastal waters. This is an indication that primary production continues during winter. Generally, the surface concentrations during winter were similar to the bottom concentrations. During late spring 1986, the concentrations of nutrients at the surface and below the densicline were significantly lower than during winter. Only at the Atlantic boundary in the north, and near the estuaries, were higher concentrations detected. In stratified parts of the North Sea, the decomposition of sediment biomass caused ammonia concentrations in the bottom layer to be significantly higher in spring than in winter. Incidents of frontal upwelling in the central North Sea introduced nutrient-rich bottom water into the euphotic zone, enhancing phytoplankton growth in the central North Sea during summer. Ratios of nitrogen nutrients to phosphate showed that in the central North Sea, nitrogen was a limiting factor rather than phosphorus. The opposite was true in the continental coastal water and off England. Riverine input and trapping mechanisms in the estuaries and tidal flats caused concentrations of organic matter to be highest in the coastal zones and to decrease seaward. Budget calculations for the different nutrient elements showed that in the North Sea the biological turnover greatly exceeded the estimated annual inflow and outflow of nutrient elements. (Mertz-PTT)
W91-12393

ROLE OF BACTERIA IN THE NORTH SEA ECOSYSTEM.
Brussels Univ. (Belgium).
G. Billen, C. Joiris, L. Meyer-Reil, and H. Linderboom.
Netherlands Journal of Sea Research NJSRBA, Vol. 26, No. 2/4, p 265-293, November 1990. 21 fig, 6 tab, 221 ref.

Descriptors: *Bacterial analysis, *Marine sediments, *North Sea, Evaluation, Fluctuations, Literature review, Organic matter, Phytoplankton, Primary production, Seasonal variation, Sediment traps, Sedimentation, Water column.

A critical examination of the methodology utilized for measuring standing stock and activities of bacteria in the water column and the sediments of the North Sea was examined. Measurements of planktonic bacterial biomass showed important seasonal and geographical variations, related, with a delay of about 10 days, to phytoplanktonic development. Assessment of the standing stock and turnover rate of high molecular weight dissolved organic matter and monomeric substrates provided data consistent with the view that extracellular enzymatic hydrolysis of polymers was limiting the rate of organic matter utilization; uptake of direct substrates was rapid and their concentration were maintained at a near constant level. The flux of organic matter flowing through the planktonic bacteria compartment was evaluated to about 110 g C/sq m/year in the coastal continental zone. Bacterial production rates showed a growth yield in the range of 0.1 to 0.4. In the Central North Sea, data were lacking to an allow accurate estimation of planktonic bacterial activity on an annual basis. However, the available information suggested that a lower percentage of primary production was used by bacteria there. A crude estimate of the flux of organic matter sedimentation based on sediment traps measurements and organic matter utilization rates by benthic organisms derived from oxidant or nutrient budgets, yielded values in the range of 50-100 g C/sq m/year in the Central North Sea. (Mertz-PTT)
W91-12394

GULF: PAST, PRESENT AND POSSIBLE FUTURE STATES.
Newcastle upon Tyne Univ. (England). Centre for Tropical Coastal Management Studies.
For primary bibliographic entry see Field 6G.
W91-12401

DEGRADATION OF HALOGENATED PHENOLS IN ANOXIC NATURAL MARINE SEDIMENTS.
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
For primary bibliographic entry see Field 5B.
W91-12402

DISSOLVED AND PARTICULATE TRACE METALS IN SURFACE WATERS OVER THE DOGGER BANK, CENTRAL NORTH SEA.
Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab.
For primary bibliographic entry see Field 5B.
W91-12405

SURVEY OF SHORELINE LITTER IN HALIFAX HARBOUR 1989.
Dalhousie Univ., Halifax (Nova Scotia). School for Resource and Environmental Studies.
For primary bibliographic entry see Field 5B.
W91-12406

METALS IN MYTILUS EDULIS FROM THE NORTHERN COAST OF PORTUGAL.
Porto Univ. (Portugal). Dept. de Fisiologia.
For primary bibliographic entry see Field 5B.
W91-12407

SOURCES AND TRANSPORT OF HYDROCARBONS IN THE RHONE DELTA SEDIMENTS (NORTHWESTERN MEDITERRANEAN).
Paris-6 Univ. (France). Lab. de Physique et Chimie Marines.
For primary bibliographic entry see Field 5B.
W91-12478

DISSOLVED OXYGEN CONCENTRATIONS IN HYPERSALINE WATERS.
Warrnambool Inst. of Advanced Education (Australia). Faculty of Applied Science and Technology.
J. E. Sherwood, F. Stagnitti, M. J. Kokkinn, and W. D. Williams.
Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 235-250, March 1991. 2 fig, 7 tab, 39 ref.

Descriptors: *Dissolved oxygen, *Henrys Law, *Hypersalinity, *Salinity, *Water chemistry, Electrolytes, Laboratory methods, Mathematical equations, Sodium chloride, Temperature.

Henry's law constants (ko) and equilibrium concentrations (Co*) of dissolved oxygen (DO) at 1 atm were measured in NaCl solutions of concentration (S) to approximately 260 ppt and temperatures (T) between 273 and 308 K. An equation relating the natural log (ln) of Co* to T and S was developed that predicted DO values within the experimental uncertainty. An equation of the same form satisfactorily described the variation of ln ko over the same temperature and concentration ranges. To develop these equations it was also necessary to describe the variation of density and vapor pressure of NaCl solutions with T and S. The equations can be used to generate tables of oxygen solubility values that can be used for hypersaline waters dominated by NaCl. Theoretically, DO values based on NaCl can be corrected for the presence of other ionic salts in natural waters. At present this correction is limited by the availability of DO data for these subdominant electrolytes. (Author's abstract)
W91-12482

NUTRIENTS AND CHLOROPHYLL AT THE INTERFACE OF A WATERSHED AND AN ESTUARY.
Smithsonian Environmental Research Center, Edgewater, MD.
T. E. Jordan, D. L. Correll, J. Miklas, and D. E. Weller.
Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 251-267, March 1991. 11 fig, 3 tab, 46 ref. NSF Grants BSR 79-11563, BSR 82-07212, BSR 83-16948, and BSR 86-15902 and EPA Grant R804536601.

Descriptors: *Chesapeake Bay, *Chlorophyll, *Estuaries, *Maryland, *Nutrient transport, *Nutrients, *Runoff, Coastal waters, Nitrogen, Phosphorus, Primary productivity, Rhode River.

Estuaries function as important sinks and transformers of nutrients, thus altering the quantity and quality of nutrients transported from the land to the sea. The fates of nutrients entering the Rhode River (Chesapeake Bay, Maryland) estuary from its watershed and from atmospheric deposition were investigated. Production or consumption of materials in the upper estuary was calculated from

a mixing model with chloride as a conservative tracer. The upper estuary produced chlorophyll and dissolved PO4(3-) (DPO4(3-)) but consumed particulate PO4(3-), total inorganic N, dissolved organic N, and particulate organic C. These net fluxes were influenced more by shallow, open-water areas than by the tidal marshes that cover two-thirds of the area of the upper estuary. Ratios of chlorophyll to organic C, N, and P suggest that most of the suspended particulate organic matter in the upper estuary was produced by phytoplankton rather than derived from watershed inputs. The consumption of nitrate due to phytoplankton production and the production of DPO4(3-) due to release from particulate P after deposition in sediments resulted in low inorganic N:P ratios, contrasting sharply with the lower estuary and the adjacent Chesapeake Bay. Dissolved inorganic N and P entered the upper estuary from the watershed at an atomic ratio of 26 but left the upper estuary at a ratio of 2.7. The release of DPO4(3-) from watershed-derived sediments may be a common feature among estuaries that could promote N limitation of primary production in estuarine and coastal waters. (Author's abstract)
W91-12483

WEAK COUPLING OF BACTERIAL AND ALGAL PRODUCTION IN A HETEROTROPHIC ECOSYSTEM: THE HUDSON RIVER ESTUARY.
Institute of Ecosystem Studies, Millbrook, NY.
S. Findlay, M. L. Pace, D. Lints, J. L. Cole, and N. F. Caraco.
Limnology and Oceanography LIOCAH, Vol. 36, No. 2, p 268-278, March 1991. 9 fig, 1 tab, 36 ref.

Descriptors: *Algae, *Aquatic bacteria, *Ecosystems, *Estuarine environment, *Hudson Estuary, *New York, *Productivity, Biomass, Organic carbon, Phytoplankton, River continuum concept, Seasonal distribution, Secondary productivity.

Large rivers represent an important class of ecosystems, and a prevalent paradigm in lotic ecology, the river continuum concept, suggests that large streams and rivers should be dependent on loadings of organic C from upstream. Bacterial abundances, biomass, and production were measured over a 3-yr period at stations along a 158-km reach of the tidal, freshwater Hudson River. Bacterial abundances ranged from 1 to 10 million cells/ml, with maximal values in summer. Abundance and production averaged over all stations for the ice-free season (April through December) were 4.9 and 9.1 billion cells/L per day, respectively, and both were correlated significantly with temperature. Neither bacterial abundance nor production showed significant spatial variability over the study reach (Castleton to Haverstraw Bay). In contrast to the results from many autotrophic ecosystems, annual average bacterial abundances from different stations were not correlated significantly with algal standing stocks and bacterial production was related only weakly to rates of primary production. Absolute rates of bacterial C production were greater than phytoplankton primary production, indicating that much of the bacterial secondary production in this portion of the river must be supported by nonphytoplanktonic organic C. (Author's abstract)
W91-12484

SPATIAL AND TEMPORAL VARIABILITIES OF HYPOXIA IN THE RAPPAHANNOCK RIVER, VIRGINIA.
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5B.
W91-12495

SUMMER OXYGEN DEPLETION IN A DIKED NEW ENGLAND ESTUARY.
Cape Cod National Seashore, South Wellfleet, MA.
J. W. Portnoy.
Estuaries ESTUDO, Vol. 14, No. 2, p 122-129, June 1991. 5 fig, 2 tab, 25 ref.

Descriptors: *Environmental effects, *Estuaries, *Herring River Estuary, *Oxygen deficit, *Salt marshes, Anoxia, Flushing, Massachusetts, Organic matter, Rainfall-runoff relationships, Temperature.

The diked and freshened Herring River estuary (Wellfleet, Massachusetts) experiences regular summer hypoxia and one-week to three-week periods of main stream anoxia, often accompanied by fish kills. Stream hypoxia results from the temperature-dependent increase in oxygen demand of organic matter released by diked salt marsh deposits; periods of total anoxia are induced by heavy rains which increase the runoff of wetland organic matter. Historic reductions in tidal flushing have extended the low salinity region of the estuarry normally characterized by high organic loads and minimal flushing. Recurrent main stream anoxia has depressed both migratory and resident aquatic fauna. (Author's abstract)
W91-12496

TIDE GAUGE RECORDS, WATER LEVEL RISE, AND SUBSIDENCE IN THE NORTHERN GULF OF MEXICO.
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
R. E. Turner.
Estuaries ESTUDO, Vol. 14, No. 2, p 139-147, June 1991. 7 fig, 3 tab, 36 ref.

Descriptors: *Deltas, *Geomorphology, *Gulf of Mexico, *Sea level, *Subsidence, *Water level fluctuations, Florida, Louisiana, Historic data, Land use, Texas.

Long-term water level changes in the northern Gulf of Mexico were examined using tide gauge records for this century. Strong coherence exists between the annual mean water changes at Galveston, Texas, and (1) the relatively geologically stable west coast of Florida; (2) global mean sea level; and (3) the subsiding Louisiana coast. Water levels at the Galveston gauge, one of the longest records (81 yr), have risen steadily, but not accelerated over the long-term. The apparent acceleration of water rise in the recent two decades is within the historical pattern, and is probably driven by regional or global, but not local climatic factors. Because eustatic sea level has risen steadily this century, the analysis supports the conclusion that regional geologic subsidence has not varied significantly over the tide gauge record (1909-1988). Variations in the estimates of subsidence in the surface layers are generally consistent with the generally accepted understanding of the geology of deltaic processes on this coast. (Author's abstract)
W91-12497

EFFECTS OF SEA SALTS ON THE FORMS OF NITROGEN RELEASED FROM ESTUARINE AND FRESHWATER SEDIMENTS: DOES ION PAIRING AFFECT AMMONIUM FLUX.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
W. S. Gardner, S. P. Seitzinger, and J. M. Malczyk.
Estuaries ESTUDO, Vol. 14, No. 2, p 157-166, June 1991. 6 fig, 28 ref.

Descriptors: *Ammonium, *Cycling nutrients, *Environmental chemistry, *Estuaries, *Nitrogen, *Salts, *Sediment chemistry, *Wetlands, Barnegat Bay, Cation exchange, Denitrification, Diffusion, Florida, Lake Michigan, New Jersey, Nitrification, Ochlockonee River, Saline water, Sorption, Toms River.

In sediments with oxidized surface layers, the percentage of mineralized nitrogen that is nitrified/denitrified, compared with that released directly as ammonium, appears to be affected by the presence of sea salts. In estuarine systems, a significant portion of the nitrogen is released as ammonium, whereas in freshwater systems, most of the mineralized nitrogen is often released from the sediments as nitrogen gas. This discrepancy is though to be caused by differential competition between physical diffusion and nitrification/denitrification in the two systems. The vertical migration (by Fickian diffusion) of ammonium out of the oxic layer may be hindered by cation exchange (or sorption) interactions with sediment particles to a greater extent in fresh water than in estuarine systems. The resulting relatively long residence time, and potentially high levels of particle-bound ammonium in the freshwater sediments, would favor nitrification as the major ammonium removal process. By contrast, ion pair formation of ammonium with seawater anions and blockage of sediment cation exchange sites with seawater cations may allow a sizable fraction of the ammonium to diffuse out of estuarine sediments before it is nitrified. A salt effect, consistent with this hypothesis, has been demonstrated in experimental systems by changing the ionic composition of water flowing above intact cores of freshwater and estuarine sediments. Steady-state ammonium release from Lake Michigan sediments was substantially enhanced in the presence of 30% seawater over that in the presence of lake water alone. Likewise, steady-state ammonium release, from Ochlockonee River and Bay sediments (Florida) and from Toms River and Barnegat Bay sediments (New Jersey), was usually higher in the presence of diluted synthetic seawater than it was in the presence of fresh water. (Author's abstract)
W91-12499

EFFECT OF SALINITY ON AMMONIUM SORPTION IN AQUATIC SEDIMENTS: IMPLICATIONS FOR BENTHIC NUTRIENT RECYCLING.
Academy of Natural Sciences of Philadelphia, PA. Div. of Environmental Research.
S. P. Seitzinger, W. S. Gardner, and A. K. Spratt.
Estuaries ESTUDO, Vol. 14, No. 2, p 167-174, June 1991. 5 fig, 1 tab, 41 ref.

Descriptors: *Ammonium, *Benthic environment, *Cycling nutrients, *Environmental chemistry, *Marine sediments, *Salinity, Cation exchange, Freshwater, Model studies, Nitrification, Nitrogen, Saline water, Sediment chemistry.

Ambient exchangeable ammonium concentrations in freshwater sediments are generally considerably greater than those reported for marine sediments. Laboratory measurements indicate that competition for cation exchange sites by ions in seawater is a factor responsible for the lower exchangeable ammonium concentrations in marine sediments. Exchangeable ammonium concentrations were 3-fold to 6-fold higher when river and estuarine sediments were incubated with freshwater relative to the same sediments incubated with salt water (23 parts per thousand). A model was developed to explore the implications for benthic nitrogen cycling of this salinity effect on exchangeable ammonium concentrations. Ammonium diffusion, exchangeable and dissolved ammonium concentrations, and nitrification rates were components of the model formulation. The model output suggests that higher exchangeable ammonium concentrations predicted in fresh water relative to marine sediments can markedly increase the fraction of the ammonium produced in sediments that are nitrified (and subsequently denitrified). These results are consistent with field and experimental laboratory data which indicate that a larger percentage of net ammonium production in aerobic freshwater sediments is nitrified and denitrified (80-100%) relative to marine sediments (40-60%). (Author's abstract)
W91-12500

LOSS ON IGNITION AND KJELDAHL DIGESTION FOR ESTIMATING ORGANIC CARBON AND TOTAL NITROGEN IN ESTUARINE MARSH SOILS: CALIBRATION WITH DRY COMBUSTION.
Duke Univ., Durham, NC. Duke Environmental Center.
For primary bibliographic entry see Field 7B.
W91-12501

SPATIAL DISTRIBUTIONS OF THE SOFT-STEM BULRUSH, SCIRPUS VALIDUS, ACROSS A SALINITY GRADIENT.
Florida Cooperative Fish and Wildlife Research Unit, Gainesville.

P. J. Latham, L. G. Pearlstine, and W. M. Kitchens.
Estuaries ESTUDO, Vol. 14, No. 2, p 192-198, June 1991. 5 fig, 3 tab, 41 ref. Fish and Wildlife Service Cooperative Agreement No. 14-16-000901544-WO30.

Descriptors: *Bulrushes, *Salinity gradients, *Salt marshes, *Spatial distribution, *Tidal marshes, *Wetlands, Biomass, Population dynamics, Salinity.

Spatial distribution patterns of Scirpus validus were studied in tidal marshes of the lower Savannah River. The hypothesis that changes in spatial pattern for S. validus would accompany differences in environmental parameters was tested by sampling densities and biomass along environmental gradients of salinity and elevation. Coefficients of dispersion were calculated for S. validus and used to compare spatial patterns among freshwater, mildly oligohaline, strongly oligohaline, and mesohaline tidal marshes. Results indicated significantly greater clumping of S. validus in mesohaline marsh than in freshwater marsh. Only the mildly oligohaline site supported a random population of S. validus, while the strongly oligohaline marsh supported a uniform spatial distribution. Spatial pattern and relative importance of S. validus, as well as composition of co-occurring species, changed significantly with changing salinity. The relations between changes in relative importance of S. validus and differences in soil organic matter and elevation were also significant. (Author's abstract)
W91-12502

SPECIES-SPECIFIC SEDIMENTATION AND SINKING VELOCITIES OF DIATOMS.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
U. Passow.
Marine Biology MBIOAJ, Vol. 108, No. 3, p 449-455, April 1991. 4 fig, 2 tab, 45 ref.

Descriptors: *Diatoms, *Limnology, *Sedimentation, *Species composition, Chrysophyta, Growth stages, Life history studies, Seasonal variation.

Sedimentation rates were determined for various diatom species, and both average and maximum sinking velocities of sedimenting diatoms were calculated during a spring bloom investigation in the central Baltic Sea in 1986. Up to 25 and 50% of the Chaetoceros spp. and Thalassiosira levanderi populations, respectively, sedimented daily. Daily sedimentation rates of other diatoms, dinoflagellates and Mesodinium rubrum, however, were $< 1\%$ of their respective standing stocks. The T. levanderi population was divided into two subpopulations: while one was sinking, the second was actively dividing (recognizable by paired-cell stages) with a specific growth rate of > 0.2 to 0.3/d. These paired cells were never found in sediment trap samples. The average sinking velocity of Chaetoceros spp. was 15 to 30 m/d; that of T. levanderi was higher. The maximum sinking velocity of cells was at least 70 m/d. According to these observations, the formation of aggregates (which enhances sinking velocity), and their sedimentation, represent a highly selective process. This indicates that diatom aggregates do not act as roving filters, sweeping the water clear while sinking. (Author's abstract)
W91-12520

UPTAKE OF CADMIUM IN TROPICAL MARINE LAMELLIBRANCHES, AND EFFECTS ON PHYSIOLOGICAL BEHAVIOUR.
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
For primary bibliographic entry see Field 5B.
W91-12521

ION(NA)-HOLDING CAPACITY OF MICROBIAL BIOMASS UNDER SALINE CONDITIONS.
Tokyo Univ. of Agriculture and Technology (Japan). Faculty of Agriculture.
G. Shokohifard, R. Hamada, and K. Sakagami.
Soil Biology & Biochemistry SBIOAH, Vol. 22, No. 7, p 993-994, 1990. 1 fig, 1 tab, 8 ref.

Descriptors: *Biomass, *Environmental chemistry, *Saline soils, *Saline water irrigation, *Salinity, *Sodium, *Wetlands, Ammonium, Bacteria, Biochemistry, Escherichia coli, Microbiological studies.

In order to determine the ion(Na)-holding capacity of the microbial biomass of pure cultures of Azotobacter vinelandii, Bacillus subtilis, Escherichia coli, Pseudomonas fluorescens, Staphylococcus aureus, and Streptococcus mutans, under saline conditions, 500 mg of fresh microbial biomass was placed in a test tube, 5 mL of salt (NaCl) solution containing 25 mg of Na was added to it, and the mixture was kept at 25 C for 24 hr. Then contents of the tubes were centrifuged, the supernatant was collected, and its Na concentration measured. The detected ion was termed 'free ion'. The residue was treated with 2 mL of 80% ethanol, mechanically shaken for 1 min, centrifuged, and Na detected in the supernatant was termed 'ethanol released ion' (loosely held). The procedure was repeated by adding 2 mL of normal ammonium acetate (pH 7) to the residue to measure the 'ammonium acetate released ion' (tightly held). The ion-holding capacity was calculated by subtracting the amount of 'free ion' (Na) from the added ion (Na). Under saline conditions, E. coli and P. fluorescens held the greatest amounts of Na, 85.8 and 83.7 mg/gm dry wt, respectively, while the lowest value (74.3) was obtained for S. aureus. The microorganisms with lower initial Na contents held lesser amounts of Na under saline conditions, except for St. mutans. The strength of the ion-holding function of B. subtilis and S. aureus were relatively higher, indicating that these microorganisms strongly bound some Na in their cell systems so that it was not released (undetected portion) even after treatment with ammonium acetate solution. For P. fluorescens a large portion of the held Na was released by ethanol. The Na may have been attached to the outer membrane of the microbial biomass. (Lantz-PTT)
W91-12524

ROLE OF INTERTIDAL MUDBANKS IN THE DIAGENESIS AND EXPORT OF DISSOLVED AND PARTICULATE MATERIALS FROM THE FLY DELTA, PAPUA NEW GUINEA.
Australian Inst. of Marine Sciences, Townsville.
D. M. Alongi.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 149, No. 1, p 81-107, July 1, 1991. 10 fig, 5 tab, 75 ref.

Descriptors: *Diagenesis, *Fly Delta, *Intertidal areas, *Mudbanks, *Particulate matter, *Wetlands, Ammonia, Bacteria, Benthic environment, Benthos, Biomass, Carbon, Dissolved organic carbon, Marine sediments, New Guinea, Nitrates, Nitrites, Nitrogen, Nutrients, Organic matter, Phosphates, Phosphorus, Primary productivity.

Benthic processes and sedimentary structures of intertidal mudbanks within the Fly Delta, Papua New Guinea, were examined to assess their role in the storage, utilization and export of nutrients from the river delta to the adjacent Gulf of Papua. Three types of mudbanks were recognized based on interpretation of X-radiographs of sediment cores: a physically dominated, high sedimentation regime (one station), a biologically dominated, low-to-moderate sedimentation regime (one station) and a 'transitional' regime (two stations). Meiofaunal and macroinfaunal densities varied widely, being lowest at the physically controlled site and dominated mainly by small deposit-, and suspension-feeding polychaetes, amphipods, oligochaetes and nematodes. Infaunal biomass was low across stations. Bacterial densities were highest at the physically and biologically controlled sites. Bacterial C production was estimated from rates of protein and DNA synthesis. The methods did not agree well, with rates of DNA synthesis several times higher than production estimates derived from tritiated leucine incorporation. However, specific growth rates derived using both methods correlated strongly, with high rates across 20 cm depth horizons at all four stations. Levels of particulate organic C, total N, total P in the sediments and dissolved organic (DOC, DON, DOP) and inorganic (NH4(+), NO2(-) + NO3(-), Si(OH)4(+), PO$(3-)) nutrients in the porewaters were low compared to other benthic habitats and generally varied little with sediment depth. The average stoichiometric ratio of solid-phase nutrients was low, suggesting that the material was in very early stages of diagenesis. Fluxes of dissolved inorganic and organic nutrients across the sediment-water interface were mostly undetectable and rates of O2 consumption and gross primary production were low, as were chlorophyll a and phaeopigments. The two transitional stations had large quantities of deposited macroparticulate plant litter. It is proposed that the rapidly growing, bacterial communities in these sediments sequester and mineralize most of the labile organic matter deposited on to these mudbanks, leading to the observed lack of nutrient flux across the sediment-water interface. (Author's abstract)
W91-12531

REVIEW OF CURRENT SALT MARSH MANAGEMENT ISSUES IN FLORIDA.
Indian River Mosquito Control District, Vero Beach, FL.
For primary bibliographic entry see Field 4A.
W91-12551

SEDIMENT TRANSPORT OF FINE SANDS AT HIGH VELOCITIES.
Ministry of Transport and Public Works, Dordrecht (Netherlands).
For primary bibliographic entry see Field 8B.
W91-12562

COMPUTER SIMULATIONS OF THE HYDRODYNAMIC AND SALINITY BEHAVIOR OF WEEKS BAY, ALABAMA, AT EQUATORIAL TIDE CONDITIONS.
Alabama Univ., University. Dept. of Chemical Engineering.
A. Thollapalli, G. C. April, D. C. Raney, W. W. Schroeder, and B. C. McCormick.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 165-169, 1991. 3 fig, 2 tab, 4 ref.

Descriptors: *Computer models, *Estuaries, *Hydrodynamics, *Model studies, *Salinity, *Simulation analysis, *Weeks Bay, Alabama, Data interpretation, Flooding, Management planning, Mobile Bay, Tidal hydraulics, WIFM model, Water quality.

The Weeks Bay estuary is a small tributary estuary on the eastern shore of Mobile Bay in the Northern Gulf of Mexico. The Bay is one of seventeen national estuarine research reserves established for long-term scientific and educational programs that will provide information essential to coastal management decision making. The hydrodynamic and salinity behavior of Weeks Bay was investigated under equatorial tide conditions using the two-dimensional U. S. Army Corps of Engineers Waterways Experimental Station Implicit Flooding Model (WIFM). Complete data sets were chosen from the availabe field data. The results of the study revealed that, under equatorial tide conditions, the Weeks Bay system was influenced by fresh water inflows from the Fish and Magnolia Rivers. In the extreme case of significantly high flows, water movement was consistently shown to be from Weeks Bay to Mobile Bay (specifically Bon Secour Bay) during the entire equatorial tide cycle. When this was coupled with low Bon Secour Bay salinities, Weeks Bay was nearly depleted of salinity, except perhaps in the deeper channel areas near the mouth and along the eastern shore. Under more average fresh water flows, there were observed flow reversals, although the predominant flow direction was toward Mobile Bay (Bon Secour Bay)--greater levels of salt water entered the Weeks Bay system and there was a susceptibility toward stratification. The Weeks Bay system exhibited depth averaged salinities in the range of 6-8 ppt during equatorial tide conditions only when the Fish River flows were stabilized at normal or below normal conditions. (See also W91-12568) (Korn-PTT)
W91-12588

REAL-TIME MATHEMATICAL MODEL FOR THREE-DIMENSIONAL TIDAL FLOW AND WATER QUALITY.
South China Inst. for Environmental Sciences, Guangzhou.
Z. Fantang, X. Zhencheng, and C. Xiancheng.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 171-177, 1991. 3 fig, 6 ref.

Descriptors: *China, *Estuaries, *Mathematical models, *Model studies, *Pearl Estuary, *Water quality management, Boundary conditions, Data interpretation, Mathematical studies, Simulation analysis, Stratification, Tidal effects.

Three-dimensional models are required to describe the important mechanisms over a wide range of scales that may arise in estuarine areas characterized by stratification and wind-induced or tidal-induced effects. A real-time three-dimensional mathematical model for tidal waters has been developed based on the control-volume-difference method and the 'power interpolation distribution'. The concept of separating the top layer of water was employed to solve the movable boundary problem associated with three-dimensional estuary modeling. The computational scheme adopted by the model proved to be unconditionally stable and convergent. This model was applied to the Pearl River Estuary where it was used to predict the possible waste field due to a planned industrial chemical district. The pollutant enveloped areas predicted by the three-dimensional model were generally one to three times larger than those computed by a depth-averaged model. (See also W91-12568) (Korn-PTT)
W91-12589

TIDAL-FLOW, CIRCULATION, AND FLUSHING CHANGES CAUSED BY DREDGE AND FILL IN HILLSBOROUGH BAY, FLORIDA.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 4C.
W91-12649

PLANKTON STUDIES IN SAN FRANCISCO BAY, CALIFORNIA, XI. CHLOROPHYLL DISTRIBUTIONS AND HYDROGRAPHIC PROPERTIES OF SAN FRANCISCO BAY, 1988-89.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-12650

LIMNOLOGICAL CYCLE OF THE COASTAL LAGOON LA MASSONA (GIRONA, NE SPAIN): ORIGIN, DYNAMICS AND INFLUENCE OF THE SPORADIC SEAWATER INFALLS ON THE MEROMIXIS.
Institut d'Ecologia Aquatica, Gerona (Spain).
X. G. Riera, and C. A. Abella.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1029-1031, March 1991. 3 fig, 7 ref.

Descriptors: *Coastal lagoons, *La Massona Lagoon, *Limnology, *Seasonal variation, *Seawater, *Spain, *Thermocline, Aerobic conditions, Bacteria, Chemocline, Competition, Light intensity, Monimolimnion, Phytoplankton, Population density, Sediment-water interfaces, Sulfides.

Coastal lagoons are epicontinental water bodies that are usually shallow and directly or indirectly connected with the sea because of their proximity to the seashore. Their high seasonal fluctuations associated with the unpredictable influence of both marine and freshwater inputs make coastal lagoons very unstable ecosystems. La Massona is a meromictic basin that is located in the natural reserve of Alt Emporda marshes, between the rivers Fluvia and La Muga in the south of the Bay of Roses, northeast Catalonia, northeast Spain. The thermocline, when present, develops at the same depth as the chemocline. During seawater intrusion periods, the monimolimnion does not disappear but becomes aerobic up to the sediment-water interface. The sulfide concentration in the monimolimnion is higher during the summer stable phase than in the winter phase because the stability allows accumulation. The maximum of phototrophic bacteria and the 0.01% of the incident surface light are closer in the space during the summer, because of the presence of higher phytoplankton and bacterioplankton population densities. The cycle may be divided into two main phases: stable and unstable. The stable phase lasts from May to October and characterized by high stability in space and time of the physico-chemical and biological parameters. Due to an increase in sulfide levels and algal shadowing, the competition between green Chlorobiaceae and brown Chlorobiaceae is solved in favor of Chlorobium phaeovibrioides, and the green chlorobiaceae disappear as a well-defined layer. The unstable layer lasts from October to May and is characterized by low stability in space and time and very strong fluctuations due to seawater intrusions. The competition between brown and green Chlorobiaceae restarts after seawater intrusion. The duration of each phase depends on the number and distribution of seawater intrusions. (Brunone-PTT)
W91-12729

DISTRIBUTION OF SEAGRASSES ALONG THE COAST OF TAMIL NADU, SOUTHERN INDIA.
Botanical Survey of India, Howrah (India).
N. Parthasarathy, K. Ravikumar, R. Ganesan, and K. Ramamurthy.
Aquatic Botany AQBODS, Vol. 40, No. 2, p 145-153, May 1991. 1 fig, 1 tab, 11 ref.

Descriptors: *Coastal environment, *Sea grasses, *Stress, *Tamil Nadu, *Water pollution effects, Aquatic plants, Gulf of Mannar, India, Palk Bay, Pulicat Lake, Species composition, Species diversity.

The Indian subcontinent, with an extensive coastline of about 6,000 km, supports a substantial population of various tropical seagrasses chiefly concentrated in shallow, sheltered bays. In the past, sporadic collections of seagrasses have been made in various coastal belts in India. More recently, investigations on the seagrass ecosystem extended between Pulicat on the Tamil Nadu-Andhr Pradesh, India border and Kanniyakumari including the Union Territory of Pondicherry during January 1987 to September 1988. Thirty-eight stations were selected as study sites. Of the 38 stations studies, species diversity is high in the Gulf of Mannar and Palk Bay, while is low in the Bay of Bengal. The major stress on seagrass communities in the coastal zone of Tamil Nadu is pollution, through various means. Invariably in all of the stations studied, untreated domestic sewage was discharged and heavily polluted some seagrass habitats. In Ennore and Tuticorin, effluents from thermal stations are discharged into the sea, where extensive seagrass beds are bound. In Tuticorin, textile and petrochemical industry wastes were also discharged. Oil spills from boats cover the seagrass beds in localized areas. The dredging of sand for construction of jetties also results in destruction of seagrass beds and coastal erosion. In Pulicat Lake, Kaliveli tank and in Tuticorin, large portions of the aquatic ecosystem are being converted into salt pans, reducing seagrass and salt marsh cover. Reducing the human pressure on seagrass beds and covering the bare sediments through transplantation techniques to improve seagrass cover (which would indirectly help commercial fisheries) would be the effective means of managing seagrass systems in India. (Lantz-PTT)
W91-12802

PLASTIC PELLETS, TAR, AND MEGALITTER ON BEIRUT BEACHES, 1977-1988.
Prestonsburg Community Coll. KY.
For primary bibliographic entry see Field 5B.
W91-12812

RESIDENCE TIMES OF SURFACE WATER AND PARTICLE-REACTIVE 210-PB AND 210-PO IN THE EAST CHINA AND YELLOW SEAS.
Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 2K.
W91-12814

RESPONSE OF THE DELAWARE ESTUARY TO THE COMBINED FORCING FROM CHESAPEAKE BAY AND THE OCEAN.
Delaware Univ., Newark. Coll. of Marine Studies.
K. C. Wong.
Journal of Geophysical Research (C) Oceans JGRCEY, Vol. 96, No. 5, p 8797-8809, May 15, 1991. 14 fig, 22 ref. NSF Grant OCE-8515735 and NOAA Grant NA85AA-D-SG033.

Descriptors: *Chesapeake Bay, *Delaware Estuary, *Forcing, *Tidal hydraulics, *Water circulation, Delaware Canal, Estuaries, Meromixis, Tides.

Observational evidence suggests that a substantial fraction of the subtidal volume exchange in the Delaware estuary is associated with the exchange through the Chesapeake and Delaware Canal, which connects the upper reach of the Delaware estuary to the head of Chesapeake Bay. An analytical model was developed which examined the effect of the combined forcing from Chesapeake Bay and the ocean, on the Barotropic volume exchange within the Delaware estuary. The relative importance of these two forcing mechanisms depends strongly on the time scales involved. At the semidiurnal tidal frequency, remote forcing from Chesapeake Bay is not important to the exchange process in the Delaware estuary, and the response of the estuary is predominantly driven by forcing from the ocean. At subtidal frequencies, however, forcing from Chesapeake Bay via the canal is just as effective as forcing from the ocean in producing volume exchange within part of the Delaware estuary. Furthermore, the presence of the canal significantly modifies the way in which the Delaware estuary responds to forcing from the ocean. (Author's abstract)
W91-12825

SEDIMENTARY FACIES OF HOLOCENE SUBAQUEOUS CHANGJIANG RIVER DELTA (IN CHINESE).
East China Normal Univ., Shanghai.
For primary bibliographic entry see Field 2J.
W91-12835

PRELIMINARY STUDIES ON SEDIMENTATION RATE AND SEDIMENT FLUX OF THE SOUTH HYANGHAI SEA (IN CHINESE).
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 2J.
W91-12836

GENERATION OF BORES IN CONSTANT FLOW OF ESTUARY (IN CHINESE).
Ocean Univ. of Qingdao (China).
Y. Do.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 22, No. 1, p 78-83, January 1991. 1 fig, 6 ref. English summary.

Descriptors: *Boreholes, *Bores, *Estuaries, *Estuarine environment, *Tidal bores, *Tidal waves, Borehole geophysics, Friction, Gravity effects, Water currents, Wave velocity, Waves.

The shallow water nonlinear tidal wave equations with friction were analyzed on the assumption that the flow in estuary was constant. The wave front slope equation included C = characteristic wave speed, K = linear friction coefficient, g = gravitation, xb = the distance of bore generation, and A0 = initial wave front slope. When the shallow water nonlinear effect was neglected, the wave front slope was limited and a bore could not form. Results indicated that the shallow water nonlinear effect was the determinant for the generation of a bore, friction wearing off energy was a restrainer, and the opposite constant flow promotes the generation of a bore in a shorter distance. (Mertz-PTT)
W91-12838

HYDROCARBONS IN THE INDIAN OCEAN WATER (IN RUSSIAN).
Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
I. A. Nemirovskaja.
Okeanologiia OKNOAR, Vol. 31, No. 2, p 239-244, 1991. 2 fig, 3 tab, 9 ref. English summary.

Descriptors: *Hydrocarbons, *Indian Ocean, *Marine environment, *Oil pollution, Alkanes, Oil spills, Polycyclic aromatic hydrocarbons.

Oil spills and leaks have become a concern worldwide, including in the Indian Ocean. The molecular composition of alkanes and polycyclic aromatic hydrocarbons, found as dissolved and particulate forms throughout the Indian Ocean, are described, as are the differences between background and oil pollution levels of these compounds. (Author's abstract)
W91-12896

RIVER ALLUVIUM AND THE BEACH FORMATION OF THE NORTH-EAST CAUCASIAN BLACK SEA COAST (IN RUSSIAN).
Kubanskii Gosudarstvennyi Univ., Krasnodar (USSR).
For primary bibliographic entry see Field 2J.
W91-12897

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

REVERSE OSMOSIS APPLICATIONS IN SAUDI ARABIA.
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
A. M. El-Rehaili.
Journal of the American Water Works Association JAWWA5, Vol. 83, No. 6, p 72-79, June 1991. 8 fig, 16 tab, 13 ref.

Descriptors: *Desalination, *Reverse osmosis, *Saudi Arabia, *Wastewater reclamation, *Water reuse, *Water treatment, *Water treatment facilities, Desalination plants, Industrial water, Municipal wastewater, Potable water.

Rapid development during the past two decades has increased dramatically the demand for water in the Kingdom of Saudi Arabia, a country with limited potable water supplies. Two processes, desalination of seawater and brackish water and reclamation of domestic wastewater, are used extensively in Saudi Arabia to stretch its less-than-optimal supplies. Reverse osmosis (RO) is used extensively to desalinate water. Conversion rates of 60-90% are normal for desalination of brackish water at feedwater pressures of 2760 kPa. Some of the major RO plants in Saudi Arabia are: Manfouha I (27,300 cu m/day), Manfouha II (36,400 cu m/day), Malez (18,200 cu m/day), Shemessy (27,300 cu m/day), Salbukh, (38,400 cu m/day), and Buwayb (45,000 cu m/day). Most of the plants use polyamide hollow-fiber (HF) membranes; the rest use spiral-wound (SW) membranes made of cellulose acetate. Almost all the plants produce water for potable use, but a few produce water for industry, such as boiler feedwater. Among the largest RO plants desalinating seawater are Jeddah and Jeddah I (12,000 cu m/day and 57,000 cu m/day, respectively), Yanbu (5,000 cu m/day), Umm Lujj II (4,400 cu m/day). RO technology has been tested and proved efficient in a number of wastewater reclamation operations. The Petromin RO plant is an excellent example of the use of RO for reclaiming water for industry. Secondary treated municipal wastewater is the feedwater for this plant. The whole plant provides several stages of treatment, including two-stage lime treatment, cooling, filtration, carbon adsorption, dechlorination, pH adjustment and scale control, micron filtration, RO demineralization, and ion-exchange (for the highest-quality (boiler feed) water). (Rochester-PTI)
W91-12457

3B. Water Yield Improvement

THREE YEARS EXPERIENCE WITH AN ON-FARM MACRO-CATCHMENT WATER HARVESTING SYSTEM IN BOTSWANA.
International Sorghum and Millet Collaborative Research Program.
D. C. Carter, and S. Miller.
Agricultural Water Management AWMADF, Vol. 19, No. 3, p 191-203, April 1991. 5 fig, 5 tab, 9 ref.

Descriptors: *Catchment areas, *Crop yield, *Soil water, *Sorghum, *Storm runoff, *Water harvesting, *Water management, Agricultural water, Botswana, Developing countries.

An on-farm macro-catchment water harvesting system was evaluated over three distinctly different seasons in eastern Botswana. Water harvesting improved sorghum grain yield 2-3-fold during seasons with low or poorly distributed rainfall. Greater yields were associated with higher pre-planting soil moisure, higher profile soil moisture, higher water use, and a larger and deeper root system. Storms with a minimum of 20 mm/day rainfall were associated with runoff volume exceeding 1000 cu m. The probability of receiving such a storm annually during pre-planting, heading and flowering, and grain fill periods exceeded 80%. The catchment/cultivated area ratio was between 17:1 and 50:1. (Author's abstract)
W91-11601

PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR ARTIFICIAL RECHARGE IN EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11867

RUNOFF AND EROSION FOLLOWING MECHANICAL AND CHEMICAL CONTROL OF CREOSOTEBUSH (LARREA TRIDENTATA).
New Mexico State Univ., Las Cruces. Dept. of Animal and Range Sciences.
For primary bibliographic entry see Field 4A.
W91-12885

3C. Use Of Water Of Impaired Quality

IRRIGATION OF WHEAT WITH SALINE DRAINAGE WATER ON A SANDY LOAM SOIL.
Central Soil Salinity Research Inst., Karnal (India).
D. P. Sharma, K. N. Singh, K. V. G. K. Rao, and P. S. Kumbhare.
Agricultural Water Management AWMADF, Vol. 19, No. 3, p 223-233, April 1991. 6 fig, 4 tab, 17 ref.

Descriptors: *Agricultural water, *Crop yield, *Drainage water, *Irrigation, *Saline water, *Water reuse, *Wheat, Loam, Monsoons, Sandy soils.

Drainage projects to control waterlogging and soil salinity usually face an acute problem of disposal of subsurface saline drainage water out of the project area. A field experiment was conducted for 3 years on a sandy loam soil to evaluate the effects of irrigation with drainage water of different salinity levels (electrical conductivity EC=6, 9, 12 and 18-27 dS/m) on soil salinity build-up, growth and yield of wheat (Triticum aestivum). Drainage water (EC=18-27 dS/m) was diluted with canal water (EC=<1 dS/m) to obtain EC values of 6, 9 and 12 dS/m. Canal water was used for pre-sowing irrigation and subsequently saline drainage water of different salinity levels was used. Irrigation with diluted drainage water of varying salinity levels in the second and third year decreased the growth and yield significantly, whereas in the first year winter rains (102 mm), during the early growth period, seemed to have nullified the treatment effects. On average, use of 6, 9, 12 and 18-27 dS/m salinity water for 3 years resulted in 4.4, 9.2, 15.9 and 21.3% reduction in grain yield, respectively, as compared to yields with canal water irrigation. Grain protein content was not inferior even when saline drainage water was used without dilution. No problems of soil degradation were observed. Most of the salts accumulated in the preceding crop season were leached out to safe levels by monsoon rains before the next wheat season. (Author's abstract)
W91-11603

TRICKLE IRRIGATION RATES AND SOIL SALINITY DISTRIBUTION IN AN ALMOND (PRUNUS AMYGDALUS) ORCHARD.
Agricultural Research Service, Fresno, CA.
For primary bibliographic entry see Field 3F.
W91-11606

DESALINIZATION WITH SUBSURFACE DRAINAGE.
Central Soil Salinity Research Inst., Karnal (India).
K. V. G. K. Rao, and P. B. Leeds-Harrison.
Agricultural Water Management AWMADF, Vol. 19, No. 4, p 303-311, May 1991. 3 fig, 9 ref.

Descriptors: *Drainage, *Irrigation, *Land reclamation, *Saline soils, *Subsurface drainage, *Surface irrigation, *Water management, India, Laplace equation, Leaching, Simulation, Soil properties.

The desalinization by surface irrigation of a drained two-layered saline soil in Sampla, Haryana, India was simulated for different water managements aimed at increasing leaching efficiency. The Laplace equation was solved numerically to obtain the water flow pattern and a mass flow equation was applied to individual streamtubes to give the spatial and temporal distribution of salt. The simulations showed that, for the region under study, ponding of the whole surface area for 450 h at the start of the reclamation, followed by ponding in the region midway between drains of half the area for another 450 h and then ponding of only a quarter of the area for a further 450 h, results in a 50% saving of water compared with continuous ponding of the area to achieve the same desalinization. However, the partial ponding strategy results in poor quality drainage effluent for a longer time than for continuous complete ponding when rapid improvement occurs. (Author's abstract)
W91-11608

SOIL AND SWEET CHERRY RESPONSES TO IRRIGATION WITH WASTEWATER.
Agriculture Canada, Summerland (British Columbia). Research Station.
For primary bibliographic entry see Field 5E.
W91-11653

ION(NA)-HOLDING CAPACITY OF MICROBIAL BIOMASS UNDER SALINE CONDITIONS.
Tokyo Univ. of Agriculture and Technology (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 2L.
W91-12524

3D. Conservation In Domestic and Municipal Use

RESIDENTIAL WATER USE: A CASE STUDY OF THE MAJOR CITIES OF THE WESTERN REGION OF SAUDI ARABIA.
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W91-11720

PUBLIC-SUPPLY WATER USE IN FLORIDA, 1987.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 6D.
W91-11946

WATER USE AS A COMMONS DILEMMA: THE EFFECTS OF EDUCATION THAT FOCUSES ON LONG-TERM CONSEQUENCES AND INDIVIDUAL ACTION.
Pomona Coll., Claremont, CA.
S. C. Thompson, and D. Stoutmyer.
Environment and Behavior EVBHAF, Vol. 23, No. 3, p 314-333, 1991. 2 tab, 18 ref.

Descriptors: *Education, *Social aspects, *Water conservation, *Water use, *Water use efficiency, Economic aspects, Public participation, Public policy.

It was hypothesized that educational interventions that focus on the long-term consequences of water use and the efficacy of personal action to conserve would be more effective in reducing water consumption among residential water users than messages that focus on the economic advantages of conservation or a control condition that was given only tips on how to conserve. The 171 households consenting to participate in the study were randomly assigned to one of three conditions: education about long-term consequences and personal efficacy of conservation, education about the self-interested economic effect of water use, or a participation control group. A second control group of 36 households was not contacted and was unaware of the study. A second independent variable was socioeconomic status of area (SES): lower-middle versus upper-middle SES. Water use was recorded for the 2-month pre-intervention, intervention, and post-intervention periods. In support of the hypothesis, residents in the lower-middle class area conserved more water in both the intervention and post-intervention period if they received the long-term consequences and personal efficacy education. However, neither educational message had an effect in the upper-middle class area. Possible explanations for the differences in water conservation between the lower-middle and the upper-middle classes include the greater use of swimming pools and lawn sprinklers by the upper-middle class, and a greater indifference on the part of the upper-middle class to plea for water conservation for the sake of the commons. (Author's abstract)
W91-12113

EVALUATION OF MUNICIPAL WATER SUPPLY OPERATING RULES USING STOCHASTIC DOMINANCE.
National Pingtung Inst. of Agriculture (Taiwan). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 6D.
W91-12327

3F. Conservation In Agriculture

THREE YEARS EXPERIENCE WITH AN ON-FARM MACRO-CATCHMENT WATER HARVESTING SYSTEM IN BOTSWANA.
International Sorghum and Millet Collaborative Research Program.
For primary bibliographic entry see Field 3B.
W91-11601

IRRIGATION OF WHEAT WITH SALINE DRAINAGE WATER ON A SANDY LOAM SOIL.
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 3C.
W91-11603

PHYSICAL AND ECONOMIC BENEFITS OF SUBSURFACE DRAINAGE BY SOIL TYPE IN EASTERN ONTARIO.
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
H. Jorjani, and W. Van Vuuren.
Agricultural Water Management AWMADF, Vol. 19, No. 3, p 235-251, April 1991. 1 fig, 6 tab, 15 ref.

Descriptors: *Agricultural practices, *Corn, *Cost analysis, *Crop yield, *Drainage systems, *Economic aspects, *Soil texture, *Subsurface drainage, *Water management, Canada, Ontario, Precipitation, Rate of return.

The benefits from subsurface drainage for corn production in eastern Ontario, Canada, were investigated, concentrating on the interrelationship among crop yields, natural soil drainage classes, precipitation levels, soil texture, and artificial drainage. Corn yields on drained and undrained land were estimated from production functions. The data were obtained from farm observations during the period 1979-86. The independent variables are soil texture, natural soil drainage classes, and monthly precipitation levels in May through August. The first two appear as dummy variables, while precipitation is included in quadratic form. Average annual yield on drained and undrained land is estimated from the production functions by substituting the long-term mean of monthly precipitation levels in the equations. These mean values are computed from precipitation records from 1890-1986. Additional yield due to subsurface drainage is obtained by deducting the estimated average annual corn yields on undrained from that on drained land. The highest incremental yield from subsurface drainage in the study area is obtained on light and heavy soils. The economic analysis of these incremental yield records revealed that the internal rates of return (IRR) are high on light soils. Although heavy soils show relatively high incremental yields from subsurface drainage, their IRRs are low because of high installation costs. The payoff of artificial drainage on heavy soils for the sole purpose of increasing corn yield is low even at high corn prices. The big payoff occurs from being able to switch cropping patterns from low-value to high-value crops on naturally poorly drained land where these latter crops cannot be grown economically without artificial drainage. (Author's abstract)
W91-11604

DYNAMIC IRRIGATION SCHEDULING WITH STOCHASTIC RAINFALL.
Kansas State Univ., Manhattan. Dept. of Industrial Engineering.
E. S. Lee, K. S. Raju, and A. W. Biere.
Agricultural Water Management AWMADF, Vol. 19, No. 3, p 253-270, April 1991. 1 fig, 9 tab, 6 ref.

Descriptors: *Cost analysis, *Dynamic programming, *Irrigation, *Markov process, *Model studies, *Stochastic models, Computer models, Data interpretation, Microcomputers, Scheduling.

The dynamic irrigation scheduling problem with stochastic weather data was investigated by using the Markov process and dynamic programming. Several stochastic optimization models of different complexity were formulated. A simple one-stage or one-day decision model was also formulated, based on certain simplifying assumptions. This simple model not only considers the daily fluctuations of the price of the crop and the cost of irrigation, but also requires much less memory and thus can be implemented in a small personal computer. Numerical examples based on actual data were solved to illustrate the approach. (Author's abstract)
W91-11605

TRICKLE IRRIGATION RATES AND SOIL SALINITY DISTRIBUTION IN AN ALMOND (PRUNUS AMYGDALUS) ORCHARD.
Agricultural Research Service, Fresno, CA.
H. I. Nightingale, G. J. Hoffman, D. E. Rolston, and J. W. Biggar.
Agricultural Water Management AWMADF, Vol. 19, No. 3, p 271-283, April 1991. 3 fig, 4 tab, 23 ref.

Descriptors: *Almond trees, *Clay loam, *Evapotranspiration, *Irrigation effects, *Saline soils, *Saline water, *Trickle irrigation, Boron, Chlorides, Conductivity, Leaching, Root zone, Sodium.

Managing the soluble salts in the root zone of a trickle irrigated almond (Prunus amygdalus) orchard is desirable for tree growth and nut production. This study was conducted to determine the relationships among the volume (50, 100 and 150% of the crop evapotranspiration (ET-c) of trickle-applied water and the amount and distribution of soil salinity, Cl(-), B, and soluble Na(+) in a clay loam soil. Irrigation water with an electrical conductivity of 1.5 dS/m was applied for 4 years. The greatest accumulation of soil salinity (electrical conductivity of the saturation soil extract, EC-e) of 5.7 dS/m was beneath the trickle line for the 50% of ET-c treatment (14.0 cu m of applied water/tree/yr). Soil salinity decreased with distance from the trickle line. Increasing the water volume to 100 and 150% of ET-c (26.9 and 40.3 cu m/tree/yr, respectively) moves the zone of salt accumulation farther from the trickle line. The apparent leaching fraction based upon the Cl(-) ratio for the 50% of ET-c treatment was about 0.05, indicating loss of water by deep percolation within about 1 m of the trickle line. For trees irrigated at 100% of ET-c, the leaching fraction was 0.22 up to a distance of 1 m from the line, then decreased to 0.06 at a distance of 1.6 m. The leaching fraction for the 150% of ET-c treatment was from 0.36 within 1 m of the trickle line and then decreased to about 0.34 at 1.6 m from the line. Further research is required to optimize the management of trickle irrigation to meet the ET-c and leaching requirements in young almond orchards irrigated with slightly saline water. (Author's abstract)
W91-11606

MODIFIED LAYOUT OF THE SUBSURFACE DRAINAGE SYSTEM FOR RICE AREAS IN THE NILE DELTA, EGYPT.
Drainage Research Inst., Cairo (Egypt).
H. E. El-Atfy, M. Q. Abdel-Alim, and H. P. Ritzema.
Agricultural Water Management AWMADF, Vol. 19, No. 4, p 289-302, May 1991. 5 fig, 4 tab, 6 ref.

Descriptors: *Crop yield, *Irrigation, *Rice, *Subsurface drainage, *Water management, Egypt, Nile Delta.

In the Nile Delta in Egypt, rice is cultivated in rotation with 'dry-foot' crops. To reduce water losses from areas cultivated with rice without restricting drainage from other areas, a modified layout of the subsurface drainage system was developed. The modified layout is based on the crop consolidation system, in which crops are grown in units with fixed boundaries. The modified layout consists of a main collector drain with several subcollector branches. Each subcollector coincides with one crop consolidation unit and is equipped with a closing device to regulate outflow. The principles of the modified layout were investigated in experimental fields under fully controlled conditions as well as in farmers' controlled fields. The performance of the modified layout was monitored in two areas of around 2000 ha each. The introduction of the modified layout will save approximately 25% of the irrigation water supplied to rice fields, which would otherwise be lost through the subsurface drainage system. The restricted outflow has no adverse effect on soil salinity or crop yield. The introduction of the modified layout will reduce the maintenance costs of the subsurface drainage systems because the farmers are no longer forced to adopt improper practices to restrict the drainage. (Author's abstract)
W91-11607

DESALINIZATION WITH SUBSURFACE DRAINAGE.
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 3C.
W91-11608

COMPARISON BETWEEN DRIP AND FURROW IRRIGATION IN COTTON AT TWO LEVELS OF WATER SUPPLY.
Direccion General de Investigacion y Extension Agrarias, Cordoba (Spain). Dept. de Suelos y Riegos.
L. Mateos, J. Berengena, F. Orgaz, J. Diz, and E. Fereres.
Agricultural Water Management AWMADF, Vol. 19, No. 4, p 313-324, May 1991. 5 fig, 3 tab, 28 ref.

Descriptors: *Cotton, *Crop yield, *Drip irrigation, *Furrow irrigation, *Irrigation efficiency, *Soil water, Comparison studies, Evapotranspiration, Seasonal variation.

Optimal soil water status improves cotton yields by increasing flower production and boll retention and by controlling the time to maturity. Drip irrigation presumably improves the soil water regime, thus leading to higher crop yields, but the extent of its potential in cotton is unclear. A two-year experiment was carried out on a sandy loam soil at Cordoba, Spain, aimed at comparing drip against furrow irrigation in cotton. The irrigation methods were tested using a split-split-plot design which included two irrigation amounts and two or three cultivars each year. The advantage of one method over the other varied from year to year. The furrow irrigation treatments yielded significantly more than drip irrigation yields in 1985 but less in 1986. The differences in yield were explained by the crop water relations and the seasonal evapotranspiration. The 1986 results pointed to an advantage for drip irrigation under deficit irrigation conditions. Water application efficiency was 30% higher in the drip irrigation treatments, indicating a definitive advantage of this method under limited water supply. Midday leaf water potential fluctuated along the season in both drip and furrow irrigation. The fluctuations were related to the irrigation events but not to the soil water deficit. (Author's abstract)
W91-11609

IRRIGATION UNIFORMITY OF LEVEL BASINS AS INFLUENCED BY VARIATIONS IN SOIL WATER CONTENT AND SURFACE ELEVATION.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. J. Hunsaker, D. A. Bucks, and D. B. Jaynes.
Agricultural Water Management AWMADF, Vol. 19, No. 4, p 325-340, May 1991. 4 fig, 9 tab, 22 ref.

Descriptors: *Irrigation design, *Loam, *Sandy soils, *Soil water, *Surface irrigation, *Wheat, Arizona, Elevation, Infiltration.

Spatial variability in soils and surface elevation is an important consideration in the design and management of surface irrigated level basin systems. Field studies were conducted on a variable sandy loam soil in central Arizona to evaluate how the nonuniformities in the antecedent soil water content (prior to irrigation) and field surface level affected the uniformity of infiltrated water for a level basin irrigation system. Relationships between the soil water content and the sand, silt and clay fractions are described for a 4.2-ha experimental site, which was separated into 12 basins and planted to wheat in 1985 and 1986. Measured water distribution uniformities (average low quarter infiltrated depth/average infiltrated depth) were between 13-27% lower than that of an idealized uniformity of 98% where only infiltration opportunity time differences affect infiltrated depth uniformity. However, 0.51 to 0.68 of the variability in infiltrated depth could be explained by differences in the antecedent soil water content (0-1.0 m soil depth), while as much as 0.23 of the infiltrated depth variability, and 0.60 of the variability in deep percolation, was explained by nonuniformities in surface elevation. For a properly designed level basin system on sandy loam, distribution uniformities of 85% or more should be attained when 85% of the basin elevation is between +/-15 mm of the mean, provided the antecedent water content variability is on the order of 0.15 or less. However, those proposing to use level basins which have more extensive soil and water content variability should maintain a leveling precision, such that 100% of the basin is within +/-15 mm to attain high distribution uniformities. (Author's abstract)
W91-11610

DISTORTION BY WIND OF THE DISTRIBUTION PATTERNS OF SINGLE SPRINKLERS.
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
I. Seginer, D. Kantz, and D. Nir.
Agricultural Water Management AWMADF, Vol. 19, No. 4, p 341-359, May 1991. 9 fig, 2 tab, 17 ref.

Descriptors: *Distribution patterns, *Evaporation, *Irrigation, *Sprinkler irrigation, *Sprinklers, *Wind, Field tests, Simulation.

The distribution patterns of sprinklers are modified, under field conditions, by drift, evaporation and distortion, caused by wind and evaporative demand of the air. To experimentally evaluate spray loss (evaporation plus drift), collector evaporation must be suppressed or corrected for. An approximate correction, based on the measured evaporation from peripheral collectors, was applied to data obtained from a field experiment. It was assumed that spray loss is distributed over the pattern in proportion to the local rate of water application. Based on experimental results, a set of wind distorted patterns for wind speeds of 0, 2, 4, 6, and 8 m/s was obtained. These can be used for simulation under conditions similar to those encountered during the experiment. The patterns can be interpolated for any desired wind speed, rotated to the required direction and then corrected for the spray-loss appropriate to the environmental conditions. (Author's abstract)
W91-11611

GROWTH RATE AND WATER USE BY LEGUME SPECIES AT THREE SOIL TEMPERATURES.
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 2I.
W91-11613

SIMULATION OF IRRIGATION REQUIREMENTS FOR MAJOR CROPS IN SOUTH WESTERN QUEBEC.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
J. Gallichand, R. S. Broughton, J. Boisvert, and P. Rochette.
Canadian Agricultural Engineering CAEOAI, Vol. 33, No. 1, p 1-9, January 1991. 10 fig, 6 tab, 26 ref.

Descriptors: *Crop yield, *Irrigation requirements, *Model studies, *Soil moisture deficiency, *Soil water, *Soil-water-plant relationships, Canada, Clay loam, Corn, Potatoes, Quebec, Root development, Sandy soils, Soybeans, Vegetable crops.

Soil moisture simulations were performed to analyze irrigation requirements of corn, soybeans, potatoes and 6 vegetable crops grown in south western Quebec. Irrigation requirements were determined for loamy sand, clay loam, and organic soils. Ten meteorological stations within 80 km from Montreal, with record lengths varying from 22-72 years, were selected for analysis. The Versatile Soil Moisture Budget version IV was used since it has proven effective in simulating soil water content for a range of soils, crops, and climatic conditions in Canada. Results showed that a wider range of variation in the year-to-year irrigation requirements occur for crops grown on loamy sand as opposed to clay loam. The magnitude and variations of irrigation requirements during the growing season is also affected by crop rooting characteristics. For crops grown on clay loam and loamy sand, water deficits are experienced early in the growing season as a result of a shallow root system. Since irrigation requirement values were of comparable magnitude from station to station, tables giving peak and seasonal irrigation requirements for the median and 1-in-10 dry year were developed as a guide for designing irrigation equipment and reservoirs. The procedure to obtain irrigation requirements is applicable to other subhumid areas of the world for planning of irrigation systems. However, the use of the Versatile Soil Moisture Budget for irrigation scheduling would require the development of local crop coefficients and the definition of site specific parameters such as root distribution and depth, and soil profile characteristics. (Author's abstract)
W91-11647

VALIDATION OF THE UNIVERSAL SOIL LOSS EQUATION FOR THREE CROPPING SYSTEMS UNDER NATURAL RAINFALL IN SOUTHEASTERN QUEBEC.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W91-11648

YIELD RESPONSE OF GROUNDNUTS TO THE AMOUNT AND TIMING OF WATER APPLICATION.
International Center for Agricultural Research in the Dry Areas.
E. Bailey, and R. N. Boisvert.
Journal of Production Agriculture, Vol. 4, No. 1, p 1-9, January/March 1991. 6 fig, 21 ref.

Descriptors: *Available water, *Crop yield, *Drought resistance, *Irrigation, *Peanuts, Model studies, Semiarid lands, Simulation, Soil water.

Groundnut (peanut Arachis hypogaea L.) yield response to water was estimated using experimental data from the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT). These response functions are combined with historical meteorological data to simulate yield distributions in order to identify risk-efficient genotypes in areas where production is dependent on available moisture and crops may be subjected to periodic drought. Although functions commonly used were not effective in modeling the response of groundnuts to water because of the groundnuts' ability to accommodate early drought, the translog function, a polynomial in logarithms, works well. The simulated yield distributions for the 22 genotypes studied were quite different. The risk efficient sets contain from four to seven genotypes and can be reduced to only one or two genotypes when a narrow range of risk aversion is specified. (Sand-PTT)
W91-11654

LIMITING SUPPLEMENTAL IRRIGATION IN THE DELTA STATES: IMPACT ON NET RETURN AND CROPPING PATTERNS.
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Economics and Agribusiness.
S. A. Henning, and H. C. Castillo.
Journal of Production Agriculture, Vol. 4, No. 1, p 98-105, January/March 1991. 4 tab, 14 ref.

Descriptors: *Cotton, *Crop yield, *Farm management, *Irrigation requirements, *Model studies, *Rice, *Soybeans, *Supplemental irrigation, *Water requirements, Agriculture, Delta States, Economic aspects, Linear programming.

The potential for uncontrolled expansion of supplemental irrigation in the Delta States region of the USA may eventually result in limitations on supplemental agricultural water use. This study integrates information on water requirements of plants, soil productivity, and cost of production in a linear programming model to evaluate the impact on net return to producers and traditional cropping patterns in a parish when supplemental agricultural water use is restricted to less than optimal levels. Estimation of an optimal cropping pattern with unlimited supplemental water use suggests that irrigated soybean (Glycine max L. Merr.) acreage in the study area could increase 4-fold above previous census levels. However, soybeans are also sensitive to reductions in available supplemental irrigation, and the first crop to convert to nonirrigated cultural practices as supplemental water use is reduced. Net return per acre in the study area decreases nearly 7% when supplemental water use is reduced by 25%. When supplemental water use is reduced by 50%, however, and model constraints simulating the traditional croppings pattern of the area are removed, net return per acre improves. Additionally, the results indicate that cotton (Gossypium hirsutum L.) may be more competitive for the limited supplemental water resource than rice (Oryza sativa L.). This supports the hypothesis that traditional cropping patterns may not maximize net return under less than optimal conditions. (Author's abstract)
W91-11655

SEMIEMPIRICAL MODEL OF BARE SOIL EVAPORATION FOR CROP SIMULATION MODELS.
Institut National de la Recherche Agronomique, Avignon (France). Station de Bioclimatologie.
For primary bibliographic entry see Field 2D.
W91-11725

HYDROLOGIC IMPACTS OF CHANGING LAND MANAGEMENT PRACTICES IN A MODERATE-SIZED AGRICULTURAL CATCHMENT.
Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 4C.
W91-11738

PROTECTING IOWA'S COMMON WEALTH: CHALLENGES FOR THE LEOPOLD CENTER FOR SUSTAINABLE AGRICULTURE.
C. Benbrook.
Journal of Soil and Water Conservation JSWCA3, Vol. 46, No. 2, p 89-95, 10 ref. March/April 1991.

Descriptors: *Agricultural practices, *Iowa, *Soil conservation, *Water conservation, Crops, Economic aspects, Farming, Productivity, Research, Water resources management.

In a 1945 address that he called 'The Outlook for Farm Wildlife,' Aldo Leopold assessed the status of the American agricultural landscape from an ecological viewpoint. In 1987, the Iowa State Legislature passed legislation establishing the Leopold Center for Sustainable Agriculture at Iowa State University. The goal of the Leopold Center is to develop the knowledge Iowa farmers need to address the 'economic and ecological insecurities' generated by contemporary land use practices and to figure out ways to place that knowledge into widespread practice on the land. The sustainability of a production system from year to year can be threatened or enhanced by any or all of the following: (1) the productivity and conservation of soil and water resources; (2) the annual management of nutrient cycles in relation to crop needs; (3) the effective control of weeds, insects, and plant diseases; (4) changes in the prices of production inputs and farm commodities; and (5) changes in policies and community norms that influence a farmer's choice of technology, production systems, and income prospects. It is necessary to accept the necessity of long-term, continuous investments of time and money in the effort to improve the underlying productivity of soil and water resources. It is no longer good enough merely to slow down the rate of resource degradation. As farmers improve the inherent productivity of soil and the effectiveness of water management in cropping systems, they can make fuller use of currently available genetic and biological technologies. As the Leopold Center's scientific program evolves, it may gain important lessons and insights that are applicable worldwide. (White-Reimer-PTT)
W91-11748

CROP SEQUENCES AND CONSERVATION TILLAGE TO CONTROL IRRIGATION FURROW EROSION AND INCREASE FARMER INCOME.
Agricultural Research Service, Kimberly, ID. Soil and Water Management Research Unit.
D. L. Carter, and R. D. Berg.
Journal of Soil and Water Conservation JSWCA3, Vol. 46, No. 2, p 139-142, March/April 1991. 3 tab, 6 ref.

Descriptors: *Agricultural practices, *Conservation tillage, *Erosion control, *Furrow irrigation, *Irrigation practices, *Soil erosion, Crop yield, Economic aspects, Tillage.

Farmers who furrow irrigate generally regard crop residue on the soil surface as a serious deterrent to successful irrigation. This perception has prolonged the practice of moldboard plowing to bury crop residues on furrow-irrigated soils. Recent erosion control research results have led to consideration of alternative tillage practices that maintain some crop residue on the soil surface. The results of five years of research show that there are many benefits to conservation tillage on furrow-irrigated land. Conservation tillage is defined as reducing tillage operation to only those required to produce the crops grown while minimizing soil erosion. In addition, benefits were enhanced when cropping sequences were altered to accommodate the fewest number of tillage operations over the entire cropping sequence. The results showed that soil erosion can be reduced 47% to 100%, crop yields can be sustained, and farmer net income can be increased an average of more than $125/ha each year over a 5-year cropping sequence. (White-Reimer-PTT)
W91-11751

MANAGEMENT EFFECTS OF CROPS AND CROP STRIP WIDTHS ON CROP YIELD AND CONSERVATION OF SOIL AND MOISTURE ON A LIMITED-RESOURCE FARM.
Alabama A and M Univ., Normal.
For primary bibliographic entry see Field 4D.
W91-11753

NITROGEN EFFECTS ON SOIL WATER EXTRACTION BY TALL FESCUE IN NORTHERN APPALACHIA.
Agricultural Research Service, University Park, PA. Regional Pasture Research Lab.
W. L. Stout, J. A. Shaffer, G. A. Jung, T. E. Staley, and R. R. Hill.
Journal of Soil and Water Conservation JSWCA3, Vol. 46, No. 2, p 150-153 March/April 1991. 7 fig, 2 tab, 16 ref.

Descriptors: *Appalachian Mountains, *Fertilization, *Grasses, *Moisture stress, *Nitrogen, *Soil water, *Soil-water-plant relationships, *Water conservation, Biomass, Drought resistance, Fescues, Soil types, Water storage, Water use efficiency.

In the Appalachian region of the northeastern United States, droughty conditions in hill-land soils can cause moisture stress in and reduce yields of pasture grasses. In general, nitrogen (N) fertilization can improve yields and water use efficiency of forage grasses on these types of soils. However, the specific soil conditions under which N fertilization can significantly improve soil water use is not known. The effect of N fertilization of tall fescue (Festuca arundinacea Schreb.) on the water extraction from shale soils commonly found in hill-land pastures in the Northeast was investigated. Tall fescue was grown on three shale-derived soils with total available water-holding capacities of 25.3, 14.4, and 4.9 cm. Nitrogen was applied at the rate of 0, 90, and 180 kg/ha of N in a split application (50% in the spring and 50% after the first harvest). Nitrogen fertilization increased soil water extraction by tall fescue only at soil water storage capacities of 250 mm or more of available water. On soils with less than 250 mm of available water storage capacity, tall fescue was able to exploit the soil water reserves with native amounts of N, but above-ground biomass and water use efficiency was improved with N fertilization. (Author's abstract)
W91-11754

USE OF CERTAIN PLANT PARAMETERS TO DETERMINE THE PROFILE AVAILABLE WATER CAPACITY OF DURUM WHEAT AT DIFFERENT GROWTH STAGES.
Fort Hare Univ., Alice (South Africa). Dept. of Soil Science.
F. M. G. Vanassche, and M. C. Laker.
Water SA WASADV, Vol. 17, No. 2, p 161-166, April 1991. 3 fig, 3 tab, 9 ref.

Descriptors: *Irrigation practices, *Irrigation requirements, *Plant physiology, *Soil-water-plant relationships, *South Africa, *Water stress, *Wheat, Growth, Leaves, Plant tissues, Plant water potential, Root zone, Soil water, Water requirements.

Irrigation scheduling experiments were carried out to test the profile available water capacity (PAWC) concept. The lower limit of PAWC has been defined as the quantity of water in the soil profile at the degree of crop water stress at which the next irrigation should be supplied if optimum yield is to be obtained. The effect of irrigation, at extraction of different fractions of PAWC, on seasonal water use, yield and water-use efficiency was studied. The profile available water capacity (PAWC) for durum wheat was determined at different growth stages on a soil of the Limpopo series near Cradock (South Africa). In previous studies some problems were experienced with predawn leaf water potential (PLWP) as an indicator of first material stress (FMS) and other parameters had to be used. It was decided to use the stem elongation rate (SER) to indicate FMS in durum wheat plants during young growth stages. SER proved to be a reliable parameter during the early growth stages, while PLWP could indicate FMS in mature plants. It was found that young plants were more sensitive to reductions in PLWP. During young growth stages FMS was clearly identified when PLWP decreased to about -800kPa. In mature plants FMS was detected when PLWP reached a value of -1,500 kPa. The difference in leaf water potential value of mature and immature leaves stressed the importance of standardizing the method for PLWP measurements. PAWC values for durum wheat ranged from 85 mm at young growth stage to 125 mm at flowering stage. The PAWC values determined at the different growth stages indicated that the maximum PAWC value (at the flowering stage) is already reached quite some time before flowering, when the flag leaf starts to appear. This means that the PAWC value determined at the flowering stage can be used for irrigation scheduling purposes already at the end of the tillering stage. Before that time a PAWC value of 70% of the PAWC at flowering can be used. (White-Reimer-PTT)
W91-11772

PROGRESS AND PROBLEMS OF IRRIGATION INVESTMENT IN SOUTH AND SOUTHEAST ASIA.
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
S. H. Johnson.
Water Resources Journal, Vol. 166, p 45-55, September 1990. 3 fig, 10 tab, 17 ref.

Descriptors: *Asia, *Southeast Asia, *Developing countries, *Irrigation programs, *Management planning, Agriculture, Financial aspects, Investment, Irrigation, Maintenance, World Bank.

Globally irrigated agricultural areas have increased from 40 million ha in 1900 to more than 22.5 million ha. Irrigation investment has accounted for 28% of all World Bank funding during the past decade. However, since 1980 there has been a distinct decline in the rate of irrigation development. Irrigation investments have not proven to be as productive as originally expected. In fact, problems of funding for operation and management have become so acute that major donors are starting to seriously question the wisdom of additional irrigation investment. How well Third World countries are able to develop and implement programs to increase funding for operation and maintenance and improve the quality of management will determine the level of future investment in irrigation. (Author's abstract)
W91-11803

IRRIGATION OF HIGH-NITROGEN CONTAINING WASTES TO PASTURE.
Meat Industry Research Inst. of New Zealand, Hamilton.
J. M. Russell, R. N. Cooper, and A. M. Donnison.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 45-54, 4 tab, 16 ref.

Descriptors: *Irrigation water, *Pastures, *Wastewater irrigation, *Wastewater treatment, *Wastewater utilization, Biomass, Denitrification, Irrigation practices, Meat processing industry, Nitrogen removal, Nutrient removal, Pasture management, Productivity, Wastewater disposal.

Effluents from meat-processing operations contain high concentrations of the plant nutrients nitrogen (N), phosphorus (P), and potassium (K). These effluents are therefore ideal substrates for land application disposal/treatment schemes. Irrigation can be undertaken with primary-treated or biologically-treated effluent onto land that is either cropped or grazed. Irrigation transfers the environmental effect of effluent discharge from surface waters to the soil, plants and groundwater, and the groundwater and any crops grown must be safe for

subsequent use. Primary-treated effluent from a meat-processing plant was applied to experimental plots using loading rates of 0 (control), 600, 1200, and 2600 kg N/ha/yr. The denitrification losses and composition of the effluent, herbage, and leaching water were monitored. Anaerobically-treated effluent irrigation and microbiological studies were performed separately. It was found that irrigation of meat-processing effluent to pasture is successful with loading rates up to 1000 kg N/ha/yr. Some of the factors that should be considered when designing effluent irrigation schemes include: site characteristics, effluent characteristics, groundwater characteristics, pasture growth and composition, effects on soil, denitrification and ammonia volatilization, microbiological aspects, and effects of grazing animals. Pasture grown under such irrigation is both chemically and microbiologically safe for consumption by stock so long as compliance is maintained with certain strict management procedures. (See also W91-11805) (Fish-PTT)
W91-11810

DISPOSAL OF PULP AND PAPER MILL EFFLUENTS BY SPRAY IRRIGATION ONTO FARMLAND.
Tasman Pulp and Paper Co. Ltd., Kawerau (New Zealand). Technical Dept.
For primary bibliographic entry see Field 5E.
W91-11811

RECLAMATION OF A FAILED SUBSURFACE DRAINAGE SYSTEM ON AN UNSTABLE CLAY SOIL.
Victorian Crops Research Inst., Horsham (Australia).
For primary bibliographic entry see Field 2G.
W91-12254

GUAYULE BIOMASS PRODUCTION UNDER IRRIGATION.
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
F. S. Nakayama, D. A. Bucks, R. L. Roth, and B. R. Gardner.
Bioresource Technology, Vol. 35, No. 2, p 173-178, 1991. 2 fig, 2 tab, 15 ref.

Descriptors: *Arizona, *Crop yield, *Drought resistance, *Guayule, *Irrigation effects, Arid lands, Biomass, Drought, Evapotranspiration, Irrigation, Irrigation efficiency, Loam, Nitrogen, Rubber, Sandy soils, Water use efficiency.

Biomass, rubber and resin yields of the drought-tolerant guayule plant (Parthenium argentatum, Gray) can be greatly enhanced with irrigation. Irrigation studies on guayule cultivation were conducted at Mesa and Yuma, Arizona. The average annual rainfall during the 4-year period of the studies at Mesa was 150 mm, compared with 135 mm at Yuma. The Mesa soil was a Laveen loam and the Yuma soil was a Superstition sand. Three guayule cultivars were used at both locations. In arid environments, guayule yield increases were closely related to the amount of water added. Nitrogen additions also increased yields whenever water availability was not a yield-limiting factor. Yield functions were derived using evapotranspiration, as well as water and nitrogen applications as the primary variables. Water use efficiencies for biomass production of irrigated guayule were in the order of 0.7 kg/cu m for the Mesa site and 0.5 kg/cu m for the Yuma site. The efficiency values were lower than other crops grown in the same area. Yields at reduced rates, however, were obtainable even when the plants were under extreme water stress that would be totally damaging to other crops. (Mertz-PTT)
W91-12255

THEORETICAL ANALYSIS OF FLOW RATE INTO PERFORATED DRAIN TUBES.
Lakehead Univ., Thunder Bay (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-12318

EXACT SOLUTION FOR NONLINEAR, NON-HYSTERETIC REDISTRIBUTION IN VERTICAL SOIL OF FINITE DEPTH.
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2G.
W91-12328

REPEATED MEASURE ANALYSIS OF LINE-SOURCE SPRINKLER EXPERIMENTS.
Nevada Univ. System, Reno. Dept. of Plant Science.
G. C. J. Fernandez.
HortScience HJHSAR, Vol. 26, No. 4, p 339-342, April 1991. 1 fig, 5 tab, 13 ref.

Descriptors: *Irrigation, *Irrigation efficiency, *Sprinkler irrigation, *Statistical analysis, Irrigation design, Multivariate analysis, Sprinklers, Statistical methods, Statistical models.

The feasibility of applying repeated measures analysis to line-source sprinkler systems and the comparison of repeated measures analysis with multivariate methods was examined. The repeated measures analysis was readily available in the Statistical Analysis System general linear model and Analysis of Variance procedures. In repeated measure analysis, a particular choice of contrast transformations provides additional insight into the data being studied. In the Statistical Analysis System, several contrast transformations could be specified, neither univariate nor multivariate test statistics were affected by the type of transformation. Yield data from an irrigation experiment using the line-source sprinkler systems were used to illustrate the repeated measures analysis. Multivariate tests using a matrix procedure were easily obtained using multivariate Analysis of Variance and multivariate options. Repeated measures analysis was recommended for the analysis of data obtained from experiments with repeated measurements either over time or space. Univariate analysis was suitable if the H-F condition was valid. If the H-F condition is not met, adjusted univariate analysis or multivariate tests should be used. (Mertz-PTT)
W91-12382

TILLAGE AND CROP RESIDUE MANAGEMENT AFFECT VERTISOL PROPERTIES AND GRAIN SORGHUM GROWTH OVER SEVEN YEARS IN THE SEMI-ARID SUB-TROPICS. 1. CROP RESIDUE AND SOIL WATER DURING FALLOW PERIODS.
Queensland Dept. of Primary Industries, Toowoomba (Australia). Wheat Research Inst.
G. A. Thomas, J. Standley, A. A. Webb, G. W. Blight, and H. M. Hunter.
Soil and Tillage Research SOTRD5, Vol. 17, No. 3/4, p 181-197, September 1990. 2 fig, 8 tab, 21 ref.

Descriptors: *Cropping, *Fallowing, *Land use, *Soil properties, *Soil water, *Tillage, Australia, Environmental effects, Rainfall, Seasonal variation, Soil-water-plant relationships.

The effects of fallow surface management treatments on stubble (crop residue) levels and soil water storage were studied during seven fallow periods between grain sorghum crops on a gray Vertisol near Biloela in central Queensland, Australia. Treatments were disc (D), blade (B) and zero (Z) tillage, each with stubble or residue from preceeding crops either retained (+) or removed (-) at the start of the fallow periods, which were of 7-8 months duration. Where stubble was retained, stubble dry matter levels on the soil surface at the start of the fallow period were mainly influenced by stubble produced by the previous crop, but also by residual stubble on the soil surface before the previous crop. The general order was D+ < B+ < Z+. Stubble dry matter and stubble cover on the soil surface declined during the fallow period in all stubble-retained treatments, with the greatest reductions occurring after the initial disc or blade tillage. From the start to end of the fallow, mean reductions in stubble dry matter and stubble cover were 60 and 74% in D+, 31 and 57% in B+, and 17 and 24% in Z+. Mean stubble dry matter levels on the soil surface at the end of the fallow period in December-January were 1030, 2030, and 2910 kg/ha in D+, B+ and Z+, respectively; corresponding stubble cover levels were 8, 16 and 35%. Mean plant available water capacity to 1.8 was 201 mm. Mean fallow soil water accumulation varied between fallow periods from 11 to 102 mm. The corresponding variation in mean fallow water storage efficiency (percent of rainfall over the fallow stored in the soil) was from 3 to 37%. During the fallow period, B+ and Z+ generally resulted in higher plant available water than other treatments at mean values of 50-100 mm. However, these effects were not present at higher plant available water levels, as occurred at the end of six fallow periods. (Lantz-PTT)
W91-12525

EFFECTS OF PLOUGHLESS TILLAGE AND STRAW INCORPORATION ON EVAPORATION.
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Soil Sciences.
T. Rydberg.
Soil and Tillage Research SOTRD5, Vol. 17, No. 3/4, p 303-314, September 1990. 6 fig, 2 tab, 22 ref.

Descriptors: *Environmental effects, *Evaporation, *Soil water, *Straw, *Tillage, *Water conservation, Agricultural practices, Agriculture, Clays, Cultivation, Land use, Lysimeters, Precipitation, Silty soils, Sweden.

The effects of ploughless tillage (stubble cultivation with a disc tiller or a spring tine cultivator, or with both in combination, replacing mouldboard plowing) on evaporation were investigated using undisturbed soil lysimeters (height=350 mm, diameter=300 mm) excavated after spring cultivation in May from field experiments in eastern Sweden. The evaporation process was measured on plowed and unplowed soil lysimeters, both with or without precipitation and with or without a seedbed. The effects on evaporation of incorporating crop residues with or without precipitation into a ploughed seedbed were also measured. The results from a heavy clay and form silty clay loam showed that both ploughless tillage and incorporated straw reduced cumulative evaporation. The water-conserving effect was greater in irrigated treatments. The positive effect on water conservation was also greater on the silty clay loam than on the heavy clay. The soil structural changes brought about by ploughless tillage in layers under the seedbed acted to reduce the rate of evaporation from soil. (Author's abstract)
W91-12528

EFFECT OF TILLAGE AND RESIDUE MANAGEMENT ON HYDRO-THERMAL REGIME, NUTRIENT UPTAKE AND YIELD OF WHEAT IN A RIVER DEPOSIT.
Himachal Pradesh Krishi Vishva Vidyalaya, Palampur (India). Dept. of Soil Sciences and Water Management.
R. M. Bhagat.
Soil and Tillage Research SOTRD5, Vol. 17, No. 3/4, p 315-326, September 1990. 5 fig, 5 tab, 30 ref.

Descriptors: *Agricultural practices, *Crop yield, *Nutrients, *Riparian land, *Soil water, *Soil-water-plant relationships, *Tillage, *Wheat, Agriculture, Manure, Organic matter, Soil properties, Soil temperature.

Field experiments were conducted on a river deposit during 1983-84 and 1984-85 in order to study the effect of different soil management practices, such as zero tillage with surface-applied crop residue mulch at a rate of 10 t/hr (ZT+M), conventional tillage (CT), CT+surface applied crop residue much at a rate of 10 t/ha (CT+M), CT+crop residue incorporation at a rate of 10 t/ha (CT+SI). CT+farmyard manure incorporation at a rate of 10 t/ha (CT+FYM), on soil hydrothermal regime, root growth, nutrient uptake and dry matter yield of winter wheat (Triticum aestivum L.). The soils of the site are classified as Entisol, Typic Psammaquent with pH 6.0, cation exchange capacity 10 c mol (p+)/kg in the surface (0-0.3 m) depth. In the CT+M and CT+FYM treatments, higher water retention was observed compared to CI. The mini-

mum soil temperature was also raised by about 3 C under CT+M compared to CT at 0.1 m depth. CT+M and CT+FYM had significantly higher root mass density compared with other treatments at all stages of crop growth. The nitrogen (N) uptake under these two treatments was also significantly higher compared to CT. Under CT+M, plants did not suffer from N stress compared to other treatments. Phosphorus (P) uptake (except at tillering) and potassium (K) uptake under CT+M and CT+FYM were significantly higher than for all the other treatments. Treatments ZT+M and CT+SI behave similarly to CT in terms of hydrothermal regime, root growth, nutrient uptake and dry matter yield. The grain yield under CT+M and CT+FYM during 1983-84 and 1984-85 was significantly higher than that under all the other treatments. (Author's abstract)
W91-12529

SOILS OF THE FLOOD PLAIN OF OYUN RIVER IN THE SOUTHERN GUINEA SAVANNA OF NIGERIA AND THEIR CROP PRODUCTION POTENTIAL.
Ilorin Univ. (Nigeria). Dept. of Crop Production.
For primary bibliographic entry see Field 2G.
W91-12533

HEAT SHOCK PROTEIN EXPRESSION IN THERMOTOLERANT AND THERMOSENSITIVE LINES OF COTTON.
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
For primary bibliographic entry see Field 2I.
W91-12631

POLYMER EFFECTS ON THE HYDRAULIC CONDUCTIVITY OF SALINE AND SODIC SOIL CONDITIONS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
E. A. El-Morsy, M. Malik, and J. Letey.
Soil Science SOSCAK, Vol. 151, No. 6, p 430-435, June 1991. 3 fig, 8 ref.

Descriptors: *Hydraulic conductivity, *Irrigation water, *Polymers, *Saline soils, *Soil water, Chemical analysis, Guar, Irrigation practices, Polyacrylamides, Polysaccharides, Soil properties.

Water used for irrigation in many semiarid regions of the world contains high levels of salinity and/or sodicity, which affect hydraulic conductivity. Polymers mixed with the irrigation water may also affect hydraulic conductivity. The hydraulic conductivity of a Haplic Durixeralf soil classified as Arlington sandy loam, was measured in disturbed laboratory columns using waters of various electrolyte concentrations, sodium adsorption ratios, and with or without a polymer. Cationic polysaccharide, guar derivative (CP-14), and very low negative charge polyacrylamide (2J) polymers were investigated. After passing several pore volumes of water through the soil, the soil was removed from the column, dried, sieved, and repacked into the columns. The hydraulic conductivity was then measured using city of Riverside, CA tap water. The greatest increase in hydraulic conductivity with CP-14, compared to the control, occurred with a sodium adsorption ratio (SAR) equal to 5, and at the two highest electrolyte concentrations. The 2J polymer was most effective in increasing hydraulic conductivity when it was added to the high electrolyte solution. During the second run with tap water, the hydraulic conductivity for no polymer and CP-14 treatments were similar to each other and less than the 2J treatment. The polyacrylamide apparently promoted aggregate stability to the soil when it was dried, whereas the guar did not. This behavior may be caused by the high molecular weight of the polyacrylamide. (Author's abstract)
W91-12900

WATER AND LAND USE AND THE NORTH AMERICAN PRAIRIE.
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 4B.
W91-12924

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

HEURISTIC OPERATING POLICIES FOR RESERVOIR SYSTEM SIMULATION.
Worcester Polytechnic Inst., MA. Dept. of Management.
S. A. Johnson, J. R. Stedinger, and K. Staschus.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 673-685, May 1991. 3 fig, 4 tab, 42 ref. NSF Grant CEE-8351819.

Descriptors: *Model studies, *Operating policies, *Optimization, *Reservoir operation, *Simulation analysis, Drawdown, Reservoir storage, Reservoir yield, Simulation, Spills.

Reservoir system simulations models are widely used to determine a system's firm water yield. Theoretical motivation was developed for the space rule and NYC's equal-probability-of-spill rule. Such general heuristic guidelines can be combined with constraints on system operation to yield one-period optimization models that identify reasonable operating policies for water resource system simulations. One-period models for periods when reservoirs are refilling were developed that generated end-of-period storages satisfying the water or energy space rule, or minimized an approximation to expected spill, when such storages were feasible. An optimization model was also developed for periods when reservoirs were being drawn down. The space rule and drawdown rule were incorporated into the objective of a monthly optimization model in the revised CVPower simulation program. Use of these one-period optimization models improved the simulated operation of the Central Valley Project in California over the critical period of record and provided reasonable policies for other hydrologic scenarios. Such models could also prove useful in simulations with smaller or larger time steps, provided that inflow forecasts for future periods are available and water transit times within the system are not of concern. (Doria-PTT)
W91-11721

STOCHASTIC DYNAMIC PROGRAMMING FOR RESERVOIR OPTIMAL CONTROL: DENSE DISCRETIZATION AND INFLOW CORRELATION ASSUMPTION MADE POSSIBLE BY PARALLEL COMPUTING.
Politecnico di Milano (Italy). Dipt. di Elettronica.
C. Piccardi, and R. Soncini-Sessa.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 729-741, May 1991. 6 fig, 23 ref.

Descriptors: *Computers, *Dynamic programming, *Model studies, *Optimization, *Parallel computing, *Reservoir operation, *Stochastic process, Algorithms, Correlation analysis, Numerical analysis, Storage.

The solution via dynamic programming (DP) of a reservoir optimal control problem is often computationally prohibitive when the proper description of the inflow process leads to a system model having several state variables or when a sufficiently dense state discretization is required to achieve numerical accuracy. Thus, to simplify, the inflow correlation is usually neglected and/or a coarse state discretization is adopted. However, these simplifications may significantly affect the reliability of the solution of the optimization problem. Nowadays, the availability of very powerful computers based on innovative architectures (vector and parallel machines), even in the domain of personal computers (transputer architectures), stimulates the reformulation of the standard dynamic programming algorithm in a form able to exploit these new machine architectures. The reformulated DP algorithm and new machines enable faster and less costly solution of optimization problems involving a system model having two state variables (storage and previous period inflow, then taking into account the inflow correlation) and a number of states (of the order of 10,000) such as to guarantee a high numerical accuracy. (Author's abstract)
W91-11726

TAKING ADVANTAGE OF STORMWATER CONTROL BASINS IN URBAN LANDSCAPES.
Georgia Univ., Athens. School of Environmental Design.
B. K. Ferguson.
Journal of Soil and Water Conservation JSWCA3, Vol. 46, No. 2, p 100-103, March/April 1991. 11 ref.

Descriptors: *Detention reservoirs, *Flood control, *Landscaping, *Storm runoff, *Storm water management, *Urban runoff, Aesthetics, Design criteria, Economic aspects, Recreation.

Flood control, base flow control, and water quality concerns frequently mandate storage and treatment of urban runoff. Consequently, urban developers have a new line item in their construction program. In addition to roads, houses, and parking lots, there must be some sort of runoff storage basin. It is possible to mold stormwater basins into integrated components of the urban landscape in ways that provide aesthetic, recreational, maintenance, economic, and ecological values. When used positively, stormwater basins can contribute to the human and natural environment. They can be sculpted, planted, contoured, and built of the right kinds of material on a site-specific basis. Any approach to design of stormwater basins must be flexible and creative. The broad views, intuition, and artistic imagination of urban design must be considered simultaneously with mathematical derivation of hydraulic and structural performance. In setting landscape patterns, designers can take into account the type of expected user; the position of the basin relative to roads, viewers, and houses; the need for active recreation versus passive scenery; the amount of space and water available; existing desirable or objectionable features; and the design character and variety of the overall site. (White-Reimer-PTT)
W91-11750

REGIONAL CLIMATE CHANGE IMPACTS: II. IMPACTS ON WATER MANAGEMENT WORKS.
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W91-11796

EVALUATION OF POLICIES FOR OPERATION OF RESERVOIR SYSTEMS (EVALUATION DES REGLES D'EXPLOITATION DE SYSTEMES DE RESERVOIRS).
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
A. G. Acosta, G. Leclerc, and M. Tremblay.
Canadian Journal of Civil Engineering CJCEB8, Vol. 18, No. 2, p 214-224, April 1991. 4 fig, 13 tab, 11 ref. English summary.

Descriptors: *Reservoir operation, *Reservoir releases, *Reservoirs, *Risk assessment, Failure, Management planning, Operating policies.

During the reservoir operating phase, evaluation of the risks of failure generates additional information that is essential for the management of water reservoirs. This information elucidates the selection of a release policy for the mid-range operating horizon and helps to determine, at the beginning of each period of the short-range horizon, if risks of failure resulting from the application of the current release policy remain acceptable. A method was developed for the evaluation of risks of failure of a reservoir system that employs variables not explicitly accounted for in the determination of the release policy for the mid-range horizon. The evaluation method employs a stochastic simulation model to reproduce the evolution of the system operated according to the current release policy. It estimates the risk of the various types of failure for a known state of the system at the beginning of a decision

period and those that system may reach at the beginnings of the other periods of the evaluation horizon. The method may also be used to compute the statistics of the various types of failure encountered and of the net benefits. The evaluation method has been applied to a system involving one reservoir and one powerhouse (reservoir volume 14,030 cu hm, installed capacity 420 MW in Quebec, Canada). (Author's abstract)
W91-12082

STOCHASTIC STUDY OF FLOODS IN CANADA: FREQUENCY ANALYSIS AND REGIONALIZATION.
Department of Fisheries and Oceans, Moncton (New Brunswick). Science Branch.
For primary bibliographic entry see Field 2E.
W91-12083

MULTI-DAY FLOW FORECASTING USING THE KALMAN FILTER.
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-12088

CASE HISTORIES OF ATTEMPTS TO REMOVE THREE SMALL ICE JAMS.
British Columbia Ministry of Environment, Kamloops. Water Management.
For primary bibliographic entry see Field 2C.
W91-12090

STATUS AND PROSPECTS OF HYDROPOWER IN AUSTRIA.
Oesterreichische Elektrizitaetswirtschafts A.G., Vienna.
For primary bibliographic entry see Field 8C.
W91-12195

REVIEW OF RESERVOIR FUNCTIONS IN CZECHOSLOVAKIA.
Ceske Vysoke Uceni Technicke v Praze. Katedra Hydrotechniky.
For primary bibliographic entry see Field 8A.
W91-12201

FORECASTING IN OPTIMIZING DUAL SYSTEM FOR ENERGY GENERATION AND IRRIGATION.
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
G. Oron, A. Mehrez, and G. Rabinowitz.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 117, No. 3, p 287-300, May/June 1991. 1 fig, 5 tab, 21 ref, append.

Descriptors: *Hydroelectric power, *Irrigation, *Management planning, *Multipurpose reservoirs, *Reservoir operation, Economic aspects, Forecasting, Hazbani-Dan Project, Israel, Optimization, Stochastic process.

Recorded and actual inflow rates play a critical role in the planning and operation of hydroelectric systems. The stochastic variations in water inflow and varying water demands cause difficulties in real-time control of the overall system. A nonlinear decision-control model for real-time operation of a dual-purpose water system for electrical energy generation and irrigation has been developed. Maximal return depends on the implemented flow-rate forecasting method and varying costs for energy sold to an external utility. A case study was conducted using the Hazbani-Dan System, Israel. This water system is characterized by varying inflows into the collection basin, daily and hourly changes in upstream water consumption above the collection basin, a constant release of water at the diverting basin, and limitations of flow into the reservoir when storage reaches a specified upper limit. The results of two forecasting models and the historical data were compared, indicating the importance of an accurate data base for supporting the decision toward optimal operation of time-dependent water systems. The results from the Hazbani-Dan project indicate that forecasting errors are associated with a decrease in benefits as measured by the expected annual returns. (Rochester-PTT)
W91-12202

NETWORK FLOW MODELING OF OROVILLE COMPLEX.
Snowy Mountains Engineering Corp., Cooma (Australia).
H. Sabet, and C. L. Creel.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 117, No. 3, p 301-320, May/June 1991. 8 fig, 3 tab, 12 ref.

Descriptors: *California, *Model studies, *Network Flow Programming, *Optimization, *Oroville Reservoir System, *Reservoir operation, Feasibility studies, Mathematical models, Nonlinear programming, Systems engineering.

The Network Flow Programming (NFP) technique can be used to solve models characterized by a linear objective and constraints. Nonlinear systems also may be solved iteratively using NFP in conjunction with linearization methods. NFP was used to simulate the operation of the Oroville reservoir system of the California State Water Project (SWP). The simulation used three integrated NFP models developed and calibrated to simulate the hydraulic operation, hydropower generation, and contractual obligations of the California Department of Water Resources (CDWR) to deliver energy to Southern California Edison (SCE). The simulation is performed on weekly and daily levels, with up-to-hourly detail. The boundary conditions for the periodic operation are determined by ORONET, which is designed to meet SWP demands downstream of the complex while minimizing deviation from target storage in the facility reservoirs for an entire week or day. The periodic operation (hourly detail on a daily level) is determined using OROPRD. This model screens the feasibility of a desired electrical generation pattern to best meet SWP power loads. The CDWR and SCE shares of generation are determined using THANET, which accounts for water and power shares of both agencies using OROPRD results. Although NFP is a linear model, it was adapted easily to modeling the Oroville complex nonlinear system in conjunction with linearization techniques and stepwise simulation. These models have been in use since January 1989 for scheduling the operation of SWP facilities. (Rochester-PTT)
W91-12203

INTEGER PROGRAMMING APPLICATION FOR PLANNING OF HYDROPOWER PRODUCTION.
Southern California Edison Co., El Monte.
T. Trezos.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 117, No. 3, p 340-351, May/June 1991. 4 fig, 8 ref.

Descriptors: *California, *Hydroelectric plants, *Management planning, *Mathematical models, *Model studies, *Multireservoir networks, *Reservoir operation, Big Creek, Computer programs, Optimization, Performance evaluation, Seasonal variation, Systems analysis.

Big Creek is a system of six major reservoirs and nine powerhouses located on the west side of the Sierra Nevada mountains, approximately 200 mi north of Los Angeles, California. The system has an installed capacity of 1000 MW. A mixed integer programming model was developed for water management in Southern California Edison's Big Creek hydroelectric facility. The model is deterministic, with monthly decision variables and annual optimization horizons. The objective is the maximization of the total value of the produced energy. the model is intended primarily for long-term planning. However, the introduction of a new power plant in 1987 reduced the guidance value of the recorded pattern of historical operations that have been improved based on dispatchers' experience over a long period of time. Consequently, the model is found to be very useful in determining short-term (annual or semiannual) operating policies. Its principal output is a water-release policy during on-peak and off-peak periods for 12 consecutive months. The optimization program requires approx 70 sec of processing time to run on an IBM 3081 mainframe computer to derive the water-release schedule for one water year. For 17 consecutive years tested, the model reproduced the historical operation satisfactorily. Overall, the model slightly overestimated the annual energy production (by no more than 5%); this was more apparent during wet years. (Rochester-PTT)
W91-12205

EFFICACY OF SWMM APPLICATION.
Texas Univ. at Dallas, Richardson. Inst. for Environmental Sciences.
J. J. Warwick, and P. Tadepalli.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 117, No. 3, p 352-366, May/June 1991. 6 fig, 8 tab, 25 ref.

Descriptors: *Mathematical models, *Model studies, *Rainfall-runoff relationships, *Storm water management, *Storm-Water Management Model, *Texas, *Urban hydrology, Bachman Branch, Floods, Simulation, Spatial distribution, Suspended solids, Urban areas.

The storm-water management model (SWMM) has been applied to a 10-sq mi urbanized residential area (Bachman Branch watershed, Dallas, Texas). The application was constrained intentionally to a rather gross spatial scale (no modeling of storm sewer transport) to mimic anticipated regional modeling efforts. Three different levels of watershed spatial abstraction were investigated together with the impact of using two different parameters for model calibration (pervious depression storage and percent imperviousness) along with three separate calibration events. The calibrated SWMM model performed quite well at predicting both total runoff volume and peak flow rate. Successful application was most sensitive to calibration event selection, with the smallest event resulting in the worst overall performance. The importance of watershed conceptualization level was less significant, with no noticeable difference between the highest abstraction levels. Use of percent imperviousness as the single model calibration parameter generally was more successful than adjustment of pervious depression storage. SWMM water-quality simulation also was quite acceptable, but with a consistent underestimation of the in-stream total suspended solids concentrations. (Author's abstract)
W91-12206

NEW WATER TRANSFER RESTRICTIONS: THE WEST RETURNS TO RIPARIANISM.
Chicago-Kent Coll. of Law, IL.
For primary bibliographic entry see Field 6E.
W91-12214

METHODS TO IDENTIFY AND REDUCE POTENTIAL SURFACE STREAM WATER LOSSES INTO ABANDONED UNDERGROUND MINES.
Bureau of Mines, Pittsburgh, PA. Pittsburgh Research Center.
T. E. Ackman, and J. R. Jones.
Environmental Geology and Water Sciences EGWSEI, Vol. 17, No. 3, p 227-232, May/June 1991. 6 fig, 2 tab, 9 ref.

Descriptors: *Coal mining effects, *Seepage control, *Streambeds, *Streamflow, *Streamflow depletion, *Surface water, Conductivity, Discharge measurement, Geologic fractures, Grouting, Sealants, Statistical analysis, Stream gages, Water loss.

Fractures in the strata overlying underground abandoned mines in the vicinity of streams frequently result in a loss of streamflow as water migrates along fractures associated with underground workings. Methods to identify and subsequently seal surface water loss zones in stream channels were tested by the United States Bureau of Mines at Staub Run, a first-order stream near Frostburg, Maryland. The site partially overlies abandoned coal mine workings. Conventional

stream gaging was conducted to establish discharge patterns before and after stream sealing. Electromagnetic terrain conductivity surveys were performed within the stream channel to identify zones of increased relative water saturation to depths less than 15 m. Zones of increased conductivity were generally found to be associated with areas exhibiting statistically significant (P less than or equal to 0.05) gaged flow losses. Conversely, zones that exhibited declining conductivity delineated areas where between-station flows were not significantly different. Using this information on potential loss zones, an experimental grouting procedure was applied by injecting an expandable polyurethane grout to a depth less than one meter into the alluvial streambed over a 180-m section of the stream channel. Before grouting, the study section exhibited a 24 l/sec flow loss; first-phase grouting reduced this to a 14 l/sec flow loss; with a second-phase grouting the losses were only 3 l/sec. (Author's abstract)
W91-12467

MICROBIAL LARVICIDES FOR THE CONTROL OF NUISANCE AQUATIC MIDGES (DIPTERA: CHIRONOMIDAE) INHABITING MESOCOSMS AND MAN-MADE LAKES IN CALIFORNIA.
California Univ., Riverside.
J. Rodcharoen, M. S. Mulla, and J. D. Chaney.
Journal of the American Mosquito Control Association JAMAET, Vol. 7, No. 1, p 56-62, March 1991. 4 fig, 3 tab, 11 ref.

Descriptors: *Artificial lakes, *Insect control, *Larvicides, *Midges, *Pesticides, *Ponds, Bacteria, California.

Bacillus thuringiensis var. israelensis (B.t.i.) and B. sphaericus were evaluated for chironomid larvicidal activity in man-made lakes and freshwater experimental mesocosms (ponds). Of two B.t.i. formulations, the technical powder ABG-6164 provided excellent control of chironomines (94%) at the rate of 11.2 kg/ha whereas the liquid concentrate Vectobac 6 AS, achieved only moderate control (57%) at the rate of 22.4 kg/ha. In contrast, similar rates of B. sphaericus products, ABG-6184 technical powder and BSP-2 flowable concentrate, produced no significant reduction. Lake studies were initiated to determine which B.t.i. formulations were practical and effective in large-scale situations. Two sinking granular corn grit formulations worked with varying degrees of success but were deemed too bulky for extensive applications. B.t.i. technical powder preparations with high potency ratings of 5,000 and 12,430 ITU/mg gave excellent control of Chironomus species (100% and 87%) when used at the rates of 6.7 and 2.8 kg/ha, respectively. None of the treatments reduced larval populations of the tanypodines, Procladius and Tanypus. (Author's abstract)
W91-12550

REVIEW OF CURRENT SALT MARSH MANAGEMENT ISSUES IN FLORIDA.
Indian River Mosquito Control District, Vero Beach, FL.
D. B. Carlson, P. D. O'Bryan, and J. R. Rey.
Journal of the American Mosquito Control Association JAMAET, Vol. 7, No. 1, p 83-88, March 1991. 1 tab, 27 ref.

Descriptors: *Florida, *Insect control, *Mosquitoes, *Salt marshes, *Wetlands, Environmental protection, Legal aspects, Marshes, Public policy, Wetland impoundments.

For the past decade, salt marsh management in Florida has been a central issue in attempts to reconcile mosquito control and natural resource interests. Progress has been made in trying to maintain effective mosquito control while protecting and enhancing salt marsh resources primarily due to: (1) efforts by the Florida Coordinating Council on Mosquito Control and its Subcommittee on Managed Marshes, which are committees comprised of agencies responsible for wetlands resources, those mandated to provide mosquito control, and research institutions; and (2) funding of research to investigate ecosystem effects of marsh management techniques. Research and management experience have demonstrated that Rotational Impoundment Management (RIM) and rotary ditching can provide ecologically sound source reduction benefits. Salt marsh ownership, management of state lands and mariculture remain controversial salt marsh management issues. (Author's abstract)
W91-12551

DETERMINATION OF THE AVAILABLE WATER RESOURCES OF USSR RIVERS.
A. F. Antonnikov, and L. A. Ul'yanenkova.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 534-536, 1991. 1 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 38-39, August 1990.

Descriptors: *Economic aspects, *Irrigation districts, *Reservoirs, *River management, *Water requirements, *Water resources, *Water resources management, Economic growth, Soviet Union.

Under natural conditions, the amount of river runoff limits the water resource uses available to local communities. For instance, in the southern regions of the USSR, irrigation demands are greatest in the summer months when the river runoff is lowest. The available water resources would increase through the regulation of the river runoff by constructing reservoirs in the southern rivers. Calculations are presented that show the percentage increase of available water through management of water resources. The results are compared to those of the USSR State Planning Commission and All-Union Water-Management Planning Association whose available water resource numbers were significantly lower than those presented since the positive role of using reservoirs to increase water supply was not considered. To evaluate available water resources and the economy of a river basin adequately, scientifically-based methods that include regulation of the waterways must be considered. (Collins-PTT)
W91-12621

IDENTIFICATION OF HIGH-RISK ATMOSPHERIC AND SURFACE CONDITIONS FOR URBAN FLASH FLOODING IN LOUISIANA.
Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology.
For primary bibliographic entry see Field 2E.
W91-12637

RUNOFF AND EROSION FOLLOWING MECHANICAL AND CHEMICAL CONTROL OF CREOSOTEBUSH (LARREA TRIDENTATA).
New Mexico State Univ., Las Cruces. Dept. of Animal and Range Sciences.
M. K. Wood, E. L. Garcia, and J. M. Tromble.
Weed Technology WETEE9, Vol. 5, No. 1, p 48-53, January/March 1991. 5 fig, 5 tab, 15 ref.

Descriptors: *Creosotebush, *Erosion control, *Land use, *Range management, *Runoff, *Sediment yield, *Soil erosion, Erosion, Pesticides, Sediment transport, Shrubs, Vegetation.

Runoff and sediment yield were monitored from 1983 to 1986 on a range site dominated by creosotebush (Larrea tridentata). The site was root-plowed and seeded, treated with tebuthiuron (at 36 kg ai /ha, or left untreated. Runoff from root-plowed and herbicide-treated plots was no different from untreated plots for 1 yr, but sediment yield from treated plots was lower than that from the untreated plots. Root-plowing and seeding increased sediment yield in the second year (1984), whereas treating with herbicide decreased sediment yield. Runoff and sediment yield during 1985 and 1986 were greatest from the untreated areas and least from the root-plowed and herbicide-treated areas; total cover was nearly the same for each treatment. The untreated plots had 13% shrub cover, while the others had none. Between shrubs in untreated plots, bare ground occupied large interconnected areas that contributed to the higher runoff and erosion rates. (Author's abstract)
W91-12885

NATURAL RESOURCE MANAGEMENT OF WATER AND LAND.
For primary bibliographic entry see Field 6A.
W91-12922

WATER AND LAND AND HERBIVOROUS FISH.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 88-98, 7 ref.

Descriptors: *Aquatic weed control, *Biocontrol, *Carp, *Hydrilla, *Water resources management, Fish stocking, Florida, Lake Conway, Pondweeds, Stoneworts.

In September, 1977 nearly 8,000 white amur, or Asian grass carp, were stocked in Lake Conway, a five pool, 1,800 acre lake system near Orlando, Florida. Stocking rate in each pool varied from 3 to 5 fish per surface acre; the fish weighed from 0.25 to 0.61 kg. The white amur were stocked to control the aquatic plant Hydrilla and other macrophytes which had reached nuisance levels in the lake. The results of the study were complicated by two factors unrelated to the white amur, the first of these was uncharacteristically low water levels caused by below average rainfall to the end of the study, and the second was a dramatic increase in residential development around the lake. As a result of stocking the white amur, three of the four most common aquatic plants Hydrilla, Nitella, and Potamogeton were reduced by 90% within 18 months. A fourth plant, Vallisneria, which is not readily eaten by the white amur, was not dramatically affected by the presence of the fish. The introduction of the fish and the reduction in vegetation did not significantly affect the water chemistry in Lake Conway. Declines in waterfowl, water rats, amphibians and reptiles were attributed to other factors, particularly residential development, but declines in the herbivorous turtle population was probably an effect of reduced vegetation. Another effect was increases in the numbers of phytoplankton and zooplankton, and a dramatic increase in the number of bass. However, small sized forage fish also decreased in numbers. (See also W91-12922) (Doyle-PTT)
W91-12929

BIOLOGICAL CONTROL OPERATIONS ON ALLIGATORWEED.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 101-108, 3 tab, 9 ref.

Descriptors: *Alligatorweed, *Aquatic beetles, *Aquatic weed control, *Aquatic weeds, *Biocontrol, Florida, Insects, Introduced species, Macrophytes, Ortega River.

Insects have been successfully used as a biological control agent to suppress alligatorweed in Florida and other Southeastern states. The alligatorweed flea beetle was the first host specific insect to be introduced. A research laboratory was set up in Argentina to study the flea beetle in its natural habitat and to determine whether or not the alligatorweed flea beetle could complete its life cycle on any other plant. All evidence from these studies indicated that the alligatorweed flea beetle is an obligatory monophagous insect, and is the principle suppressant of alligatorweed in its native habitat. The decision was made that this flea beetle was the most promising biocontrol for alligatorweed, and the insect was brought under quarantine, to the research laboratory in Albany, California for further research in 1963. The first release was made in South Carolina in 1964, though early results were not impressive. The first successful biological control was observed in 1965, in the Ortega River, near Jacksonville, Florida, where conditions were apparently more favorable. Alligatorweed thrips are also host specific and have been used in alligatorweed control. Infestations of alligatorweed are reduced to a negligible population

in most situations in the southeastern states where these insect controls have been released. (See also W91-12922) (Doyle-PTT)
W91-12930

DISSIPATION OF RESIDUES OF 2,4-D IN WATER, HYDROSOIL AND FISH.
Fish and Wildlife Service, Warm Springs, GA. Fish Pesticide Research Lab.
For primary bibliographic entry see Field 5B.
W91-12933

WATERHYACINTH CONTROL PLAN FOR THE ST. JOHNS RIVER.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 137-145, 5 ref.

Descriptors: *Aquatic weed control, *Management planning, *Navigable rivers, *St Johns River, *Water hyacinth, Florida, Governmental interrelationships, Phenoxy acid herbicides, Recreation, Regulations.

Waterhyacinth has been a serious problem in the St. Johns River since the U.S. Army Corps of Engineers (USACE) began controlling the plants in the navigable parts of the river in early 1900. Often the plants piled up at bridges and formed solid mats across the river for miles upstream, completely blocking navigation. A wide variety of unsuccessful control methods were tried before actual field use of 2,4-dichlorophenoxy acetic acid (2,4-D) in 1948. In 1973, the chemical treatment of waterhyacinth was declared illegal by the Environmental Protection Agency. The USACE responded by submitting an application for a specific exemption from the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act stating that the rapid and extensive growth of the waterhyacinth is a hazard to navigation and recreation activities and no known method exists that is as effective for control as this chemical. A series of meetings were undertaken between the EPA and USACE in an effort to finalize the application. The plan calls for a maintenance control approach aimed at keeping the plants at the lowest level possible by selective spraying in a manner consistent with ecological considerations and the public's use of the river. Special precautions apply to Plant nurseries and other areas where other types of plants sensitive to 2,4-D grow close to the river as well as use limitations based on such considerations as fish and wildlife migrations. The plan will be used until such time that continuing research provides acceptable biological and mechanical controls. (See also W91-12922) (Doyle-PTT)
W91-12935

CORPS OF ENGINEERS AQUATIC PLANT MANAGEMENT PROGRAM.
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 6A.
W91-12936

DEVELOPING A PLAN TO MANAGE LAKE VEGETATION.
Wisconsin Geological and Natural History Survey, Madison.
For primary bibliographic entry see Field 6A.
W91-12937

'GIANT' BLUE-GREEN ALGA.
Clemson Univ., SC. Dept. of Biological Sciences.
B. J. Speziale, G. Turner, and L. Dyck.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 161-168, 14 ref.

Descriptors: *Algal control, *Algal mats, *Cyanophyta, *Limnology, *Lyngbya, *Nuisance algae, Algal growth, Biocontrol, Eutrophication, Filamentous algae, Herbicides.

Exceptionally large celled 'giant' species of filamentous blue-green alga, Lyngbya, form undesirable floating mats in some southeastern lakes and ponds. Unlike the smaller Lyngbya species which produce an occasional patch of mucilagenous surface mat, the floating mats of giant Lyngbya are thick, robust and may extend across entire coves and small ponds. These mats may extend several feet in depth and form serious impediments to navigation, limit recreation, clog water intakes, and permeate households surrounding infested waters with a strong musty, earthy odor. A typical Lyngbya cell is huge compared to bacterial cells, having a diameter of 30-70 microns and a length of 4-7 microns. Filaments of these cells are stacked much as pennies in a roll within a firm polysaccharide sheath. The color of Lyngbya filaments varies in response to available light. Benthic mats are extraordinarily black. At the surface where light intensity is maximum, chlorophylls and phycobilins are bleached, and newly recruited surface mats are yellow-orange. Blue green filaments characteristically trail down from the underside of the surface mats, and exhibit maximum rates of photosynthesis. Laboratory studies indicate that Lyngbya infestations are associated with eutrophic, alkaline water of moderate calcium concentrations and elevated temperatures. Decreased nutrient levels diminishes the growth of blue-green algae. White amur, or Asian grass carp, successfully controlled Lyngbya in an Alabama lake reducing the infested area by 87.7% over a four year period. Diquat and copper compounds control Lyngbya, at least for short periods. The biphasic distribution of Lyngbya complicates control efforts. Spraying surface mats causes them to sink only to be replaced, within a few weeks, by healthy benthic mats. Effective, long lasting control measures should be targeted at the bottom mats. The improvement of diquat efficiency through use of novel sinking agents to carry the herbicide to the bottom mats is currently under investigation. (See also W91-12922) (Doyle-PTT)
W91-12938

AQUATIC WEEDS AND PUBLIC HEALTH.
Corps of Engineers, Washington, DC. Hydraulics and Hydrology Branch.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 169-179, 25 ref.

Descriptors: *Aquatic weed control, *Aquatic weeds, *Human diseases, *Insect control, *Public health, Algal toxins, Aquatic habitats, Mosquitoes, Recreation facilities, Snails.

Aquatic plants may have an adverse effect on public health, mainly because they provide a habitat which favors the development of vectors of human diseases. The most important types of vectors are certain mosquitoes and aquatic snails. People who visit water-related recreational areas often are exposed to ticks, mites, insects, and rodents which also may be vectors for a number of human diseases. Control of aquatic vectors such as mosquitoes can be achieved by draining water bodies since it takes a considerable time for mosquito density to build up after a body of water has dried out and refilled. Certain fresh water snails are medically significant in many areas of the world because of their role in the transmission of disease organisms. Investigations have shown that there is a positive relationship between snails and aquatic vegetation. Grass carp are effective in controlling this type of problem because they continuously feed on the vegetation, and increase the level of predation of omnivorous fish as the level of aquatic vegetation decreases. Microscopic aquatic plants, such as various blue-green algae, can produce toxins which are directly poisonous to humans and animals. Massive fish kills may be the result of blue-green algae in the food chain. Marine algal blooms ('red tides') can produce a paralytic poison, saxitoxine, which is concentrated by mollusks feeding on the algae, rendering them toxic for human consumption. (See also W91-12922) (Doyle-PTT)
W91-12939

4B. Groundwater Management

PHYSICAL AND ECONOMIC BENEFITS OF SUBSURFACE DRAINAGE BY SOIL TYPE IN EASTERN ONTARIO.
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 3F.
W91-11604

MODIFIED LAYOUT OF THE SUBSURFACE DRAINAGE SYSTEM FOR RICE AREAS IN THE NILE DELTA, EGYPT.
Drainage Research Inst., Cairo (Egypt).
For primary bibliographic entry see Field 3F.
W91-11607

EVALUATION OF WATER RESOURCES IN PART OF NORTH-CENTRAL TEXAS.
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 2F.
W91-11836

EVALUATION OF WATER RESOURCES IN PART OF CENTRAL TEXAS.
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 2F.
W91-11838

HYDROGEOLOGY OF THE MIDDLE WILCOX AQUIFER SYSTEM IN MISSISSIPPI.
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W91-11847

GROUND-WATER HYDROLOGY OF PAHVANT VALLEY AND ADJACENT AREAS.
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11857

GEOHYDROLOGY AND CHEMICAL QUALITY OF GROUND WATER, SAN BERNARDINO NATIONAL WILDLIFE REFUGE, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11859

CONSTRUCTION, LITHOLOGIC, AND GEOPHYSICAL DATA FROM MONITORING WELLS IN ALBUQUERQUE, BERNALILLO COUNTY, NEW MEXICO.
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11862

WATER USE IN THE ST. JONES RIVER BASIN, KENT COUNTY, DELAWARE, 1983-86.
Geological Survey, Towson, MD. Water Resources Div.
D. J. Phelan.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4094, 1990. 30p, 10 fig, 4 tab, 18 ref.

Descriptors: *Consumptive use, *Delaware, *Irrigation water, *Water use, Infiltration, Kent County, Return flow, Return water.

The U.S. Geological Survey, in cooperation with the Delaware Department of Natural Resources and Environmental Control (DNREC), investigated water use in the St. Jones River basin, Kent County, Delaware, from 1983 through 1986. The DNREC presently requires water use reports from users or suppliers of more than 50,000 gal/day. Quantities of water withdrawn in Delaware by

users of less than 50,000 gal/day and quantities of consumptive use are not well known. This report presents information on total water use in the St. Jones River basin in central Delaware, so that water managers can improve estimates of nonreported and consumptive water use in similar areas of the State. The largest public suppliers of water in the St. Jones River basin are the city of Dover, Dover Air Force Base, and the towns of Camden, Wyoming, and Magnolia. Pubic-supplied water use in 1985 accounted for 54% (2,363 million gallons) of all water use in the basin. Self-supplied water use accounted for the remaining 46% (1,987 million gallon). The total amount of water available for eventual discharge to the country wastewater system was about 3,130 million gal/yr. From 1983 through 1986, wastewater flow from the St. Jones basin averaged 2,147 million gal/yr. About 46% (1,430 million gal/yr) of the water supplied to systems discharging to the county wastewater system was lost to consumptive uses. (USGS)
W91-11863

GEOHYDROLOGY AND EVALUATION OF WATER RESOURCES POTENTIAL OF THE UPPER FLORIDAN AQUIFER IN THE ALBANY AREA, SOUTHWESTERN GEORGIA.
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11864

PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR ARTIFICIAL RECHARGE IN EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11867

COMPARATIVE PERFORMANCE OF INSTITUTIONAL ARRANGEMENTS FOR GROUNDWATER RESOURCES.
Indiana Univ. at Bloomington. Workshop on Political Theory and Policy Analysis.
For primary bibliographic entry see Field 6E.
W91-11877

PILOT STUDY FOR DELINEATION OF AREAS CONTRIBUTING WATER TO WELLFIELDS AT JACKSON, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 7A.
W91-11915

GROUND WATER QUALITY AND MANAGEMENT IN MINNESOTA.
Minnesota Dept. of Natural Resources, St. Paul. Div. of Waters.
For primary bibliographic entry see Field 5G.
W91-12209

ANALYSIS OF A DOMESTIC WATER WELL SURVEY.
Westinghouse Environmental and Geotechnical Services, Cary, NC.
D. L. Goodrich.
Water Well Journal WWJOA9, Vol. 45, No. 6, p 32-33, June 1991. 1 fig, 1 ref.

Descriptors: *Bedrock, *Domestic water, *New Hampshire, *Wells, Rural areas, Shallow wells, Surveys, Water yield.

In 1986 the Conservation Commission of a small town in southern New Hampshire initiated an independent survey of domestic water supply wells within its community. The responses to the survey described the water supplies serving 344 year-round residents in 136 households. The results indicated that 60% of the population was supplied by bedrock wells, 29% by shallow wells, 10% by town water, and 1% by natural springs. Bedrock wells comprised 73% of the wells, whereas the remaining 27% were shallow wells. Most bedrock well owners knew the depth of the their wells (86%) and the yield (65%). The information gathered from this survey showed that bedrock wells in this community have been drilled deeper in recent years. For private or industrial water development planning, a typical bedrock well in this area can be expected to yield approximately 11 gallons per minute at a depth of less than 250 feet. The data suggest that the probability of establishing a well that yields more than 25 gallons per minute is minimal because only 6% of the bedrock wells in the survey yielded this amount or more. (Rochester-PTT)
W91-12213

EFFECTS OF AN ORGANIC MAT FILTER ON ARTIFICIAL RECHARGE WITH TURBID WATER.
North Dakota State Water Commission, Bismarck.
W. M. Schuh.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1335-1344, June 1991. 7 fig, 1 tab, 30 ref.

Descriptors: *Artificial recharge, *Filters, *Groundwater recharge, *Recharge basins, Hydraulic conductivity, Hydraulic properties, Impedance, Infiltration rate, Organic mat filters, Porosity, Sediment load, Turbidity.

The use of an organic mat surface filter of composted sunflower seed hulls enhanced infiltration of turbid water through an artificial recharge test basin near Oakes, North Dakota. Total recharge was 81% larger for a sandy basin with the organic mat filter than for the same basin with a clean, fully renovated surface, but without the mat. Surface impedance was larger for check areas without organic mat, while areas with the mat exhibited impedance increases to greater depths. Experimental results indicated a likely trade-off between short-term recharge enhancement and an eventual larger depth of renovation to offset deeper sediment penetration under the mat. A substantial decrease in hydraulic impedance and a corresponding increase in infiltration rate were measured between 90 and 400 hours and indicated that despite large sediment influx, soil hydraulic conductivity was larger under the organic mat than for the same basin positions on clean sands using clean water. The large decrease in impedance is attributed to microbial transformation of oxygen to carbon dioxide which increased water-filled large porosity. (MacKeen-PTT)
W91-12247

SELECTING OPTIMUM DISCHARGE RATE FOR WATER WELL.
Memphis State Univ., TN. Dept. of Civil Engineering.
O. J. Helweg, and K. P. Jacob.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 7, p 934-939, July 1991. 2 fig, 1 tab, 9 ref.

Descriptors: *Cost analysis, *Economic aspects, *Flow rates, *Groundwater movement, *Operating policies, *Optimization, *Water supply, *Well yield, Drawdown, Mathematical studies, Unconfined aquifers.

The starting point to determine optimal well operation should be that which maximizes its net present worth. Recent publications and 'rules of thumb' still indicate that wells are being operated based on noneconomic criteria. One of the more popular rules of thumb suggest that drawdown should be maintained at around 50 to 60% of the saturated thickness of an unconfined aquifer. Through mathematical analysis of Driscoll's and Theim's equations and a corresponding analysis of economic criteria, the 50 to 60% drawdown rule of thumb is shown to produce water at nonoptimal costs. (Collins-PTT)
W91-12567

BACTERIAL TRANSFORMATIONS OF NITRATE AND ALDICARB (TEMIK) IN ANOXIC GROUNDWATERS OF LONG ISLAND.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5B.
W91-12629

PATHWAYS, MECHANISMS, AND RATES OF SOLUTE TRANSPORT ACROSS THE BASE OF THE FRESH WATER ZONE, SOUTH LOUISIANA.
Louisiana State Univ., Baton Rouge. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5B.
W91-12641

WATER WITHDRAWALS IN THE ROANOKE-CHOWAN SUBREGION OF NORTH CAROLINA AND VIRGINIA, 1983.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 6D.
W91-12657

WATER AND LAND USE AND THE NORTH AMERICAN PRAIRIE.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 16-23, 1 fig, 6 ref.

Descriptors: *Great Plains, *Groundwater availability, *Groundwater management, *Irrigation, *Land use, *Ogallala Aquifer, *Water conservation, *Water resource management, *Water use, Aquifers, Groundwater depletion, Groundwater irrigation, Groundwater recharge.

The North American prairie has limited rainfall of about 10-40 inches annually. Most all of the grassland areas have been converted to grainfields or are used as stock-raising pastures. Although countless aquifers lie beneath the surface of the North American prairie, they function in obscurity, and their importance is not fully appreciated until their performance is threatened Fully one-fourth of the nation's water supply comes from aquifers and is used for homes, industry, irrigation, and the maintenance of livestock; 70% of the water derived from the aquifers is used for irrigation. In most years, recharge from precipitation is enough to maintain the water ordinarily withdrawn from ther aquifers. In arid or semiarid regions, however, little or no water trickles down through the soil and water withdrawals, as in recent years, far exceed deposits. Becasue the water quality in other aquifers has been altered by long lasting chemicals such as nitrate, the Ogallala Aquifer is the only reliable source of water for many of the region's farms, ranches and small towns. In many areas water is being withdrawn from the aquifer ten times faster than it is being restored. The depth to well water is increasing from 6 inches to more than 6 feet in 11 of the states that acquire water from the Agallala Aquifer. How well the Ogallala Aquifer is managed will determine its future as well as the future of the economy and society in there areas. Although scientific developments have made dry land agriculture more attractive than it used to be, it will never be as fool proof or as appealing as drawing water from the Ogallala. (See also W91-12922) (Doyle-PTT)
W91-12924

4C. Effects On Water Of Man's Non-Water Activities

IMPACT OF HUMAN ACTIVITY ON MARINE HABITATS ALONG THE RED SEA COAST OF SAUDI ARABIA.
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W91-11621

INITIAL EFFECTS OF DEFORESTATION ON PHYSICAL CHARACTERISTICS OF A BOREAL RIVER.
Virginia Commonwealth Univ., Richmond. Dept. of Biology.

G. C. Garman, and J. R. Moring.
Hydrobiologia HYDRB8, Vol. 209, No. 1, p 29-37, February 1991. 3 fig, 1 tab, 57 ref.

Descriptors: *Deforestation, *Environmental disturbance, *Environmental effects, *Maine, *River basin development, *Rivers, *Streams, Clear-cutting, Comparison studies, Forestry, Logging, Organic matter, Piscataquis River, Stream order, Suspended solids, Thermal stratification, Watershed management, Watersheds.

The ecological patterns and processes of streams and rivers are intimately linked to the surrounding terrestrial system. Physical characteristics of the Piscataquis River, a fourth-order river in Maine, USA, were studied for one year prior to and one year following clearcut deforestation of the spruce-fir watershed. Results suggest that even the most careful, and apparently innocuous, timber harvest operation may alter the physical character of a river system. Significant changes in several factors, including thermal regime, benthic organic matter, substrate composition and suspended particulate matter were observed after logging. Changes were largely consistent with results of studies of smaller streams in deciduous forests, and with predictions of the River Continuum Concept. Post-logging conditions should favor a shift from heterotrophy to autotrophy in the trophic structure of the river community. (Author's abstract)
W91-11639

HYDROLOGIC IMPACTS OF CHANGING LAND MANAGEMENT PRACTICES IN A MODERATE-SIZED AGRICULTURAL CATCHMENT.
Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
K. W. Potter.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 845-855, May 1991. 25 fig, 1 tab, 20 ref. NSF Grant ECE-8514462.

Descriptors: *Agricultural practices, *Agricultural watersheds, *Environmental effects, *Floods, *Hydrograph analysis, *Hydrologic properties, *Land management, *Runoff, *Soil conservation, Conservation tillage, Flood peak, Gullies, Recharge, Runoff volume, Snowmelt, Streams, Wisconsin.

Soil conservation practices, if effective, should alter the hydrology of streams that drain the treated lands. This hypothesis was explored for the East Branch of the Pecatonica River, a gaged 221 square mile agricultural catchment in southwestern Wisconsin. It is clear from available data that the hydrology of the East Branch has changed dramatically during the period of record. Floods of all seasons have decreased over time, with winter/spring floods showing the greatest change. The runoff volumes associated with these floods have also decreased, while runoff volumes associated with summer/fall events of all magnitude have not changed appreciably. The rise times of all events have increased. Recharge due to snowmelt events has increased, resulting in an increase in base flow; this about compensates for the observed decrease in winter/spring volume. This is reflected in the annual statistics, which show no change in annual flow but which show a 25% decrease in the standard deviation of daily flows. The changes in hydrology are probably due to the adoption of various measures for soil and water conservation. With respect to hydrograph rise time, the treatment of gullies seems to be the critical factor. This would also explain in part the reduction in flood peaks. With respect to winter/spring flood volumes and the observed base flow increases, the adoption of conservation tillage seems to be a likely factor. (Doria-PTT)
W91-11738

INCISION AND MORPHOLOGIC EVOLUTION OF AN ALLUVIAL CHANNEL RECOVERING FROM HYDRAULIC MINING SEDIMENT.
South Carolina Univ., Columbia. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W91-11786

HYDROGEOLOGY AND GROUND-WATER-QUALITY CONDITIONS AT THE LINN COUNTY LANDFILL, EASTERN KANSAS, 1988-89.
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11865

WATER RESOURCES OF THE ISLAND OF KAHOOLAWE, HAWAII: PRELIMINARY FINDINGS.
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11916

GEOLOGIC SETTING AND WATER QUALITY OF SELECTED BASINS IN THE ACTIVE COAL-MINING AREAS OF OHIO, 1987-88.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11919

EFFECTS OF OIL PRODUCTION ON WATER RESOURCES IN THE KENTUCKY RIVER BASIN, KENTUCKY.
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W91-11922

SUMMARY OF HYDROGEOLOGIC, WATER-QUALITY, AND BIOLOGIC DATA FROM TWO SMALL BASINS, SOUTHEAST HILLSBOROUGH COUNTY, FLORIDA.
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11925

GEOHYDROLOGIC EVALUATION OF THE UPPER PART OF THE MESAVERDE GROUP, NORTHWESTERN COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
S. G. Robson, and M. Stewart.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4020, 1991. 125p, 55 fig, 1 pl, 11 tab, 83 ref.

Descriptors: *Aquifer characteristics, *Aquifers, *Coal mine effects, *Colorado, *Geochemistry, *Geohydrology, *Model studies, *Water pollution sources, Iles Formation, Routt County, Trout Creek Sandstone, Twentymile Sandstone, Williams Fork Formation.

Coal mining in Routt and Moffat Counties of northwestern Colorado has produced large areas of spoils and disturbed land that have the potential of degrading the surface and groundwater quality of the region. This investigation of the geology and hydrology of the bedrock aquifers in the area was undertaken to define the important characteristics of the hydrologic system and to evaluate the future effects of mining on water quality. Regional aquifers in the Trout Creek Sandstone Member of the Iles Formation and Twentymile Sandstone Member of the Williams Fork Formation and an important local aquifer are the principal water yielding units in the 2,000 ft-thick sequence of shale, sandstone, and coal underlying the study area. The structural complexity of the region, coupled with rugged topography, cause the irregular outcrop of the aquifer units, primarily on the back slopes of the cuestas and elevated limbs of several anticlines. The aquifers are recharged by infiltration of precipitation in the elevated outcrops. Groundwater generally moves at rates of 1 to 30 ft/year toward topographically low areas in Twentymile Park and the valleys of the Yampa River and its local tributaries. Discharge occurs by upward leakage through confining layers, lateral flow to stream valleys on low-lying outcrops, and evapotranspiration. Solute-transport modeling indicates that movement of poor quality water from spoil aquifers will not substantially degrade the water quality in the bedrock aquifers. Mining primarily will affect surface water quality through direct discharge of poor-quality spoil water into the streams from spoil springs and seeps. (USGS)
W91-11949

FATE OF LEAD FROM DUCK SHOOTING AND ROAD RUNOFF IN THREE WESTERN AUSTRALIAN WETLANDS.
Murdoch Univ. (Western Australia). School of Biological and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W91-12022

POPULATION, DEVELOPMENT AND MARINE POLLUTION IN CHINA.
Institute of Marine Environmental Protection, Dalian (China).
For primary bibliographic entry see Field 5G.
W91-12066

CHINESE AND MONGOLIAN SALINE LAKES: A LIMNOLOGICAL OVERVIEW.
Hong Kong Univ. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-12101

EFFECTS OF MIXING AND SILICA ENRICHMENT ON PHYTOPLANKTON SEASONAL SUCCESSION.
Minnesota Univ.-Duluth. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-12107

TEMPORAL CHANGES IN WETLAND LANDSCAPES OF A SECTION OF THE ST. LAWRENCE RIVER, CANADA.
Montreal Univ. (Quebec). Inst. Botanique.
For primary bibliographic entry see Field 2H.
W91-12117

RESPONSE OF A STREAM IN DISEQUILIBRIUM TO TIMBER HARVEST.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
B. H. Heede.
Environmental Management EMNGDC, Vol. 15, No. 2, p 251-255, March/April 1991. 1 fig, 2 tab, 19 ref.

Descriptors: *Channel flow, *Channel morphology, *Environmental effects, *Ephemeral streams, *Logging, *Streamflow, Knickpoints, Scarps, Sediment transport, Stream discharge, Stream erosion, Stream profiles.

Timber was harvested on the South Fork of Thomas Creek in the White Mountains of Arizona for the first time in 1978-1979. This caused significant increases in annual flow volumes and annual instantaneous peak flows. The North Fork remained untouched, but both streams were in disequilibrium before the timber harvest. Due to wetter years during the postharvest period, the North Fork also experienced some flow increases, but the difference was not significant. Flow increases cause increased erosion in disequilibrium channels. While in the South Fork channel, cross sections have enlarged by 10% since preharvest time, those in the North Fork enlarged by only 2.5%. The number of knickpoints tripled in the South Fork, which was about double that in the North Fork. Knickpoint development resulted in destruction of the natural control structures (log steps and transverse gravel bars) in the South Fork (47%), while in the North Fork they increased by 23%. Knickpoints are scarps on the channel bed that have the appearance of gully headcuts. The tripling of the number of knickpoints signifies that adjustment processes of the bed profile have intensified drastically in the South Fork. The geomorphic changes signify that, due to increases in discharge, the extent of disequilibrium is exacerbated in the South Fork. Yet, volumes of erosion are

relatively small, as will be sediment volumes leaving the watershed at a given time because of the stepwise sediment transport occurring in the ephemeral stream. (Author's abstract)
W91-12118

EVAPOTRANSPIRATION-INTERCEPTION MODEL FOR URBAN AREAS.
British Columbia Univ., Vancouver. Dept. of Geography.
For primary bibliographic entry see Field 2D.
W91-12348

HYDROGEOLOGICAL AND ENVIRONMENTAL IMPACT OF COAL MINING, JHARIA COALFIELD, INDIA.
Indian School of Mines, Dhanbad. Dept. of Applied Geology.
V. D. Choubey.
Environmental Geology and Water Sciences EGWSEI, Vol. 17, No. 3, p 185-194, May/June 1991. 11 fig, 3 tab, 19 ref.

Descriptors: *Coal mining effects, *Environmental impact, *Geohydrology, *Groundwater movement, *Groundwater quality, *Mine drainage, *Water pollution sources, Aquifer systems, Geologic fractures, Hydraulic properties, India, Subsidence, Water quality.

The Jharia coalfield is the most important and active mining region in the Damodar river valley, India. It experiences groundwater inflow and affects groundwater levels in overlying aquifers. It also provides the basis for a conceptual model of the hydrogeological impacts of coal mining. The several sandstone aquifers of the overburden are separated by aquitards that limit vertical hydraulic connection, but the inflow responds to seasonal events and seems to be linked to shallow groundwater behavior. The mine drainage behavior suggests a hydraulic connection between the mine and the shallower groundwater system. The hydrological and chemical qualities of the shallow groundwater regime in the area were evaluated by collecting water samples from 30 shallow monitoring wells. Future groundwater quality degradation as a result of mining cannot always be predicted because groundwater plays a minor role in meeting mining industry water needs. Groundwater effects, so far, have been confined to a relatively small area. The majority of subsurface water (unconfined) and groundwater (confined) has Na-Ca-SO4 and Na-MgHC3 type waters. The response of the groundwater system is influenced by the interaction of natural hydrogeological controls, the free-draining boundary of the mine, and the dynamic changes in the hydraulic properties caused by mine-related deformations. Since the hydraulic properties of the coal measure rocks are strongly controlled by the frequency, continuity, and apertures of fractures within the rocks, any alteration of the fracture properties greatly affects the groundwater flow. (Korn-PTT)
W91-12463

METHODS TO IDENTIFY AND REDUCE POTENTIAL SURFACE STREAM WATER LOSSES INTO ABANDONED UNDERGROUND MINES.
Bureau of Mines, Pittsburgh, PA. Pittsburgh Research Center.
For primary bibliographic entry see Field 4A.
W91-12467

SOIL MOVEMENT BY TILLAGE AS AFFECTED BY SLOPE.
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
For primary bibliographic entry see Field 2J.
W91-12527

STOCHASTIC MODELING OF COMBINED SEWER FLOWS.
Nebraska Natural Resources Commission, Lincoln.
S. Zheng, and V. Novotny.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 35-40, 1991. 3 fig, 1 tab, 12 ref.

Descriptors: *Combined sewer overflows, *Model studies, *Stochastic models, *Storm runoff, *Time series analysis, *Urban hydrology, ARTF Model, Data interpretation, Model testing, Pollution load, Rainfall, Real time control, Wastewater facilities.

Modeling of sewer flow and quality is essential for real-time control (RTC) of sewer systems and minimization of combined sewer overflows (CSOs). A transfer function model can be used to represent a combined sewer collection system. Following standard autoregressive moving average (ARMA) transfer function modeling concepts, the rainfall-sewer flow transformation model consists of two parts: (1) a transfer of the input rainfall into sewer flow (ARTF model); and (2) a noise term, which could be considered as dry weather sewage contributions and disturbances (SISO flow model). These two techniques were applied to time series of sewer flow data collected at the influent gate of a wastewater treatment plant in Italy. It was noted that the ARTF model provided better prediction fits and smaller sum of square residuals while both models could adequately project the future flows. Both ARTF and SISO modeling methodologies provided a powerful tool in sewer system flow and pollutant load modeling. They could be easily implemented in a computerized control scheme of a collection system with minimum data requirement and less external interference. The ARTF modeling technique may have a wide range of applications such as infiltration-inflow analyses, dry-weather/wet-weather flow separation, quality analysis, and real time control of an urban drainage system. (See also W91-12568) (Korn-PTT)
W91-12573

DEVELOPMENT OF BEST OPTIMUM SOLUTIONS TO DRAINAGE PROBLEMS.
Dundee Coll. of Technology (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W91-12579

OPERATIONAL WATER QUALITY MANAGEMENT: TRANSIENT EVENTS AND SEASONAL VARIABILITY.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-12599

TIDAL-FLOW, CIRCULATION, AND FLUSHING CHANGES CAUSED BY DREDGE AND FILL IN HILLSBOROUGH BAY, FLORIDA.
Geological Survey, Tampa, FL. Water Resources Div.
C. R. Goodwin.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-76, 1990. 124p, 34 fig, 9 tab, 53 ref. Project No. FL-159.

Descriptors: *Dredging, *Environmental impact, *Estuaries, *Florida, *Flushing, *Hillsborough Bay, *Model studies, *Water circulation, Tides.

Hillsborough Bay, Florida, has undergone extensive physical changes due to dredged construction. These changes have caused a 17% reduction in the quantity of water that enters and leaves the bay due to tidal action. A two-dimensional computer model was used to simulate changes in both tidal and residual water transport between 1880, 1972, and 1985 levels of development. Computations have revealed tide-induced residual circulation patterns consisting of 8 (in 1880) and 15 (in 1985) interconnected circulatory features that range in diameter from 0.5 to 2 miles. Changes in circulatory features since 1880, caused by dredge and fill construction, have increased circulation in parts of Hillsborough Bay from 90% to 200%. By separating total computed circulation into convective and dispersive parts, it is possible to estimate the average time of transit for dissolved or suspended material from the head to the mouth of Hillsborough Bay. The average transit time was computed to be about 58 days in 1880 and about 29 days in 1972 and 1985. One consequence of increased circulation and reduced transit times is an average salinity increase in Hillsborough Bay of about 2 parts per thousand since 1880. (USGS)
W91-12649

EFFECTS OF LAND-MANAGEMENT PRACTICES ON SEDIMENT YIELDS IN NORTHEASTERN GUILFORD COUNTY, NORTH CAROLINA.
Geological Survey, Raleigh, NC. Water Resources Div.
C. L. Hill.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4127, 1991. 40p, 10 fig, 5 tab, 34 ref.

Descriptors: *Erosion, *Land management, *Land use, *North Carolina, *Sediment yield, *Soil erosion, Best land-management practices, Guilford County, Standard land-management practices, Suspended sediments.

Data obtained from two small basins in the Piedmont province of North Carolina were used to characterize the effects of land-management practices with strip cropping, crop rotation, contour farming, and grassed waterways. The other basin represents standard land-management practices with the row orientation up and down the slope, poorly maintained grassed waterways, and the continuous production of tobacco during the growing seasons. Data collected during the 1985-87 water years were used to develop regression equations that describe the relation of suspended-sediment discharge and water discharge. The data were divided into two sets from each basin, one representing data collected during the growing season and the other representing data collected during the nongrowing season. Four regression equations were developed and analyzed for goodness-of-fit using graphical analysis, influence diagnostics, significance tests, and residuals analysis. Following refinement of the models, unit-discharge values from the 1986-88 water years were applied to the models. The resulting sediment yields were compared seasonally for each basin. On the basis of data available through 1988, sediment yields from the basin having best land-management practices were only about a tenth of the seasonal and annual yields of the basin with standard land-management practices. (USGS)
W91-12660

WATER QUALITY ASPECTS OF TWO SMALL SHALLOW MAN-MADE IMPOUNDMENTS WITH DIFFERENT WATER RESIDENCE TIMES.
Internationale Kommission zum Schutze des Rheins gege Verunreinigung, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W91-12788

NUISANCE AQUATIC MACROPHYTE GROWTH.
Corps of Engineers, Walla Walla, WA. Walla Walla District.
For primary bibliographic entry see Field 2H.
W91-12932

4D. Watershed Protection

ECONOMIC FEASIBILITY OF AGRICULTURAL MANAGEMENT PRACTICES FOR REDUCING SEDIMENTATION IN A WATER SUPPLY LAKE.
Missouri Univ.-Columbia. Dept. of Agricultural Economics.
T. Prato, and K. Dauten.
Agricultural Water Management AWMADF, Vol. 19, No. 4, p 361-370, May 1991. 4 fig, 17 ref.

Descriptors: *Agricultural watersheds, *Economic aspects, *Economic feasibility, *Land management, *Sediment control, *Water management, *Water storage, *Water supply, Clovers, Corn, Model studies, Social aspects, Soybeans, Wheat.

The economic feasibility of using alternative agricultural management practices to reduce sedimentation and enhance water storage capacity was evaluated for a water supply lake located in northern Missouri. Sedimentation of lakes is a major concern in this region because many of them serve as a municipal water supply. Net sediment delivery to the lake was estimated for 18 agricultural management practices and 8 storm events using the Agricultural Nonpoint Source Pollution (AGNPS) model. Event-based sediment delivery is aggregated to an annual basis using daily rainfall and a sediment yield curve estimated with the AGNPS model. Sediment reduction benefits are estimated by the savings in groundwater pumping costs. Many of the management practices that reduce sediment delivery to the lake are not likely to be adopted by farmers because they reduce net returns to land and management relative to practices employed in 1987 and 1988. Decreases in net returns are largest when clover replaces maize in the rotation. Net returns are somewhat lower with no tillage than with minimum tillage and highest with a maize/soybean rotation, maize/soybean/wheat rotation or continuous soybeans. Sediment reduction benefits are relatively small and insufficient to offset the decreases in net returns to farmers. Five practices increase net returns and have positive social value, namely those involving the maize/wheat, maize/soybean/wheat or continuous soybean rotation and practices that maximize total net returns in the watershed. (Author's abstract)
W91-11612

CROP SEQUENCES AND CONSERVATION TILLAGE TO CONTROL IRRIGATION FURROW EROSION AND INCREASE FARMER INCOME.
Agricultural Research Service, Kimberly, ID. Soil and Water Management Research Unit.
For primary bibliographic entry see Field 3F.
W91-11751

RELATIONSHIP OF SOIL AND PLANT CHARACTERISTICS TO EROSION AND RUNOFF ON PASTURE AND RANGE.
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 2J.
W91-11752

MANAGEMENT EFFECTS OF CROPS AND CROP STRIP WIDTHS ON CROP YIELD AND CONSERVATION OF SOIL AND MOISTURE ON A LIMITED-RESOURCE FARM.
Alabama A and M Univ., Normal.
U. R. Bishnoi, H. B. Ide, and D. A. Mays.
Journal of Soil and Water Conservation JSWCA3, Vol. 46, No. 2, p 147-150, March/April 1991. 1 fig, 6 tab, 10 ref.

Descriptors: *Agricultural practices, *Crop yield, *Erosion control, *Farm management, *Soil conservation, *Water conservation, Beans, Canopy, Corn, Crop strips, Cucumbers, Soil moisture, Soil types.

Terracing and other conventional methods of soil and water conservation are often too expensive for limited-resource farmers to implement. Therefore, research to determine the effects of three strip widths and three vegetable crops on runoff, soil loss, soil moisture, plant canopy, and crop yield was conducted on a small farm. The experimental site was located on a well-drained Baxter cherty silt loam soil (Typic Paleudult) with a 6% slope and a pH of 6.5. Three crops, sweet corn (Zea mays rugose L.), snap beans (Phaseoulus vulgaris L.); and cucumbers (Cucumis sativus L.) were planted at three different strip widths in a split-plot design with four replications, where strip widths were the main plots and crops were randomized as subplots. Runoff from the 7.3 m plot width was 60% and 13% less than that from the 1.8 m and 5.5 m plot widths, respectively. Significantly less runoff was obtained from cucumbers than from other crops. Cucumbers allowed less soil loss (1.7 Mg/ha) than sweet corn (1.8 Mg/ha) and snap beans (2.1 Mg/ha). Among the three crops, the most soil water was observed with cucumber. Significantly denser canopy cover and greater moisture was obtained with the 7.3 m strip width for all crops. Cucumber canopy was 11% and 38% greater than that for sweet corn and snap beans, respectively. Sweet corn planted in narrow strips produced a significantly higher yield (37,500 ears/ha) than sweet corn planted in wide strips (33,600 ears/ha). The highest yield of snap beans (5,890 kg/ha) was observed with a 5.5 m strip width, whereas cucumbers produced most (48,710 kg/ha) in the 7.3 m wide strip. (Author's abstract)
W91-11753

EFFECTS OF ROOT REINFORCEMENT ON SOIL-SLIP PATTERNS IN THE TRANSVERSE RANGES OF SOUTHERN CALIFORNIA.
California Univ., Los Angeles. Dept. of Geography.
V. J. Terwilliger, and L. J. Waldron.
Geological Society of America Bulletin BUGMAF, Vol. 103, No. 6, p 775-785, June 1991. 10 fig, 9 tab, 41 ref.

Descriptors: *Bank stabilization, *Landslides, *Roots, *Slope failure, *Vegetation, California, Model studies, Shear, Soil stabilization.

Effects of roots on soil slippage were investigated on unstable hillslides covered by chaparral, prescription-burned chaparral, and grassland in the Transverse Ranges of southern California. Direct shear tests were conducted on large (0.25 m x 0.61) undisturbed soil samples extracted from slip-prone landscapes under the three vegetation types. Roots were decayed from small (61 mm x25 mm) cores extracted from each large shear surface and were used to establish the strength of soil without roots. Absolute and relative contributions of roots to soil strength were very significant, although average root-strength contributions did not differ among the three vegetation types. Unburned chaparral tended to provide sparsely distributed, but occasionally great, root reinforcement. Burned chaparral and grassland landscapes provided more uniformly distributed root reinforcement with lower maximum local contributions to soil strength than chaparral. Total shear strength of soils was mobilized at greater horizontal displacements in burned and unburned chaparral than in grassland. A 3-D analysis of slope stability was developed using representative distributions of root-strength values. This model predicted systematic differences in minimum scar size between vegetation types. These differences arose not from the average root reinforcement values which were the same for each type, but rather from the differing distributions of root contributions to soil strength found for each vegetation type. This heuristic model suggests that the generally observed higher frequency of landslides in chaparral lands after conversion to grass cover may result from reduced variation in root reinforcement, which permits smaller slips to develop. (Author's abstract)
W91-11787

COAST EROSION MANAGEMENT--THE KELANTAN CASE.
Waterloopkundig Lab. te Delft, Emmeloord (Netherlands). De Voorst Lab.
W. M. K. Tilmans.
Ocean & Shoreline Management OSMAE6, Vol. 15, No. 2, p 87-124, 1991. 17 fig, 1 tab, 10 ref, append.

Descriptors: *Coastal zone management, *Erosion control, *Malaysia, Breakwaters, Case studies, Groins, Hydraulic structures, Jetties, Kelantan, Sea walls.

Human activities in the coastal zone are often supported by a physical infrastructure which, when not properly understood, can have a dramatic effect on the coastline. This was the case in Kelantan State, Malaysia, where as part of the so-called Kemasin-Semerak Integrated Rural Development Project, river outlets were stabilized by training walls. Within months of the works implementation, serious erosion occurred which endangered the seaworks and neighboring fishing boat shelters and coastal communities. A study was commissioned to investigate the cause of this erosion, taking into account both the autonomous development of the coast and the impact of the river training works, and to make recommendations for future coastal erosion management in the Kelantan State. These recommendations include: (1) in P. Datu, to construct a single groine protection some 500 m to the north of the breakwater, together with 225,000 cu m of artificial nourishment, and at the southern breakwater, to construct a landward extension of the abutment by some 25 m, or more if the borrow area of the proposed nourishment is along the coast between P. Datu and the Kemasin defence; (2) in Kemasin, create a landward extension of the abutment by some 25 m, or more, and build a single groine protection some 500 m to the south of the breakwater, together with 75,000 cu m nourishment in this area; (3) in Gali, over time, create an extension of the northern breakwater by at least 50 m in order to safeguard the drainage function of this structure, and at the southern breakwater, create a landward extension of the abutment by at least 25 m. (Lantz-PTT)
W91-11798

SITE-SPECIFIC EROSIVITY OF A SIERRA NEVADA FORESTED WATERSHED SOIL.
Nevada Univ., Reno. Dept. of Range, Wildlife and Forestry.
For primary bibliographic entry see Field 2J.
W91-11998

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

COMPARISON OF GRAIN SIZE CORRECTION PROCEDURES FOR ORGANIC MICROPOLLUTANTS AND HEAVY METALS IN MARINE SEDIMENTS.
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
J. C. Klamer, W. J. M. Hegeman, and F. Smedes.
Hydrobiologia HYDRB8, Vol. 208, No. 3, p 213-220, December 10, 1990. 5 fig, 2 tab, 19 ref.

Descriptors: *Analytical techniques, *Data quality control, *Heavy metals, *Marine pollution, *Marine sediments, *Organic pollutants, *Particle size, *Sediment contamination, Correction, Organic matter, Polychlorinated aromatic hydrocarbons, Polychlorinated biphenyls, Sampling, Sediment chemistry.

Four grain size correction procedures were tested for their applicability in comparing concentrations of heavy metals and micropollutants (PCBs, PAHs) in sediments. A simple and straightforward procedure proved best: wet sieving of fresh sediment, isolating and analyzing the <63 microm grain size fraction and expressing the pollutant concentration as a proportion of the fraction's dry weight. The total analytical errors, expressed as the variation coefficient of the average concentration, were 3.8 to 7.6% for heavy metals, 12 to 24% for PCBs and 5.3 to 9.9% for PAHs. A significant amount of the PAH still can be present in the >63 microm fraction. (Author's abstract)
W91-11635

CONCENTRATIONS OF ORGANIC CONTAMINANTS IN MOLLUSKS AND SEDIMENTS AT NOAA NATIONAL STATUS AND TREND SITES IN THE COASTAL AND ESTUARINE UNITED STATES.
National Oceanic and Atmospheric Administration, Rockville, MD. Ocean Assessments Div.
For primary bibliographic entry see Field 5B.
W91-11669

CYTOCHROME P-450 MONOOXYGENASE SYSTEMS IN AQUATIC SPECIES: CARCINOGEN METABOLISM AND BIOMARKERS FOR CARCINOGEN AND POLLUTANT EXPOSURE.

Woods Hole Oceanographic Institution, MA. Dept. of Biology.
J. J. Stegeman, and J. J. Lech.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 101-109, 1991. 2 fig, 7 tab, 74 ref. NIH Grant Nos. CA44306, ES04220, and ES01080.

Descriptors: *Bioassay, *Biochemistry, *Bioindicators, *Biotransformation, *Fish physiology, *Path of pollutants, *Pollutant identification, *Polycyclic aromatic hydrocarbons, *Toxicology, Carcinogens, Ecotoxicology, Enzymes, Laboratory methods, Polychlorinated biphenyls, Water pollution effects.

High levels of polynuclear aromatic hydrocarbon (PAH) carcinogens commonly occur in aquatic systems where neoplasms arise in fish and other animals. Enzymes that transform PAHs can act in initiating these diseases and can indicate the contamination of fish by carcinogens and other pollutants. Cytochrome P-450 has similar roles in activating PAH carcinogens in fish and mammalian species. PAHs and many chlorinated hydrocarbons, e.g., polychlorinated biphenyls (PCBs) induce a form of cytochrome P-450 in fish that is the primary catalyst of PAH metabolism. The induction of this P-450 in fish can accelerate the disposition of hydrocarbons, but can also enhance the formation of carcinogenic derivatives of PAHs. Invertebrates have lower rates of PAH metabolism than fish. These rates are not obviously inducible by exposure to PAHs or PCBs. The lower rates of foreign compound metabolism contribute to higher pollutant residue levels in bivalve mollusks (clams, mussels, etc.) than in fish and may limit the involvement of some procarcinogens (requiring activation) in disease processes in invertebrates. The induction of P-450 forms can indicate the exposure of fish to PAHs, PCBs, and other toxic compounds. Environmental induction has been detected in fish from contaminated areas by use of catalytic assay, antibodies to fish P-450, and cDNA probes that hybridize with P-450 messenger RNA. Application of these methods can provide sensitive biological monitoring tools that can detect environmental contamination of fish by some carcinogens and tumor promoters. The potential for using P-450 induction to detect direct-acting carcinogens and tumor promoters that are noninducers is limited, although such compounds can be expected to co-occur with pollutants that are inducers. (Feder-PTT)
W91-11673

CARCINOGEN ADDUCTS AS AN INDICATOR FOR THE PUBLIC HEALTH RISKS OF CONSUMING CARCINOGEN-EXPOSED FISH AND SHELLFISH.
British Columbia Cancer Research Center, Vancouver.
For primary bibliographic entry see Field 5C.
W91-11674

CRITICAL EFFECTIVE METHODS TO DETECT GENOTOXIC CARCINOGENS AND NEOPLASM-PROMOTING AGENTS.
American Health Foundation, Inc., Valhalla, NY.
J. H. Weisburger, and G. M. Williams.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 121-126, 1991. 5 tab, 60 ref. US Public Health Service Grant Nos. CA-17613, CA-24217, CA-42381, and CA-45720.

Descriptors: *Bioassay, *Biochemistry, *Bioindicators, *Carcinogens, *Fish physiology, *Path of pollutants, *Public health, *Toxicology, *Water pollution effects, Ames test, Data acquisition, Food chains, Laboratory methods, Risk assessment, Toxicity, Waste disposal.

Neoplasia in fish can result from contamination of waters with carcinogens and promoters. Cancer in fish, therefore, is a possible indicator of cancer risk to man, and serves as a guide to the need for preventive approaches involving improved means of waste disposal and environmental hygiene. Moreover, cancer in fish indicates that this important food source may be contaminated. Detection of genotoxic carcinogens to which fish have been exposed can be achieved quickly and efficiently using carefully selected batteries of complementary in vitro and in vivo bioassays. One such battery consists of the Ames test, a reverse mutation assay in prokaryotic Salmonella typhimurium, and the Williams test, involving DNA repair in freshly explanted metabolically highly competent liver cells from diverse species, including humans. Determination of DNA-carcinogen adducts by varied techniques, including P-postlabeling, as well as DNA breakage, mammalian cell mutagenicity, chromosome aberrations, sister chromatid exchange, or cell transformation represent additional approaches, each with its own advantages and disadvantages. More research is needed on systems to apprehend neoplasm promoters, but tests to determine the interruption of intercellular communications through gap junctions appear promising. Other approaches rely on the measurement of enzymes such as ornithine decarboxylase and protein kinase C. Approaches to the definition of risk to fish or humans require: characterization of the genotoxic or nongenotoxic properties of a chemical; relative potency data obtained in select, limited rodent bioassays; and, knowledge of prevailing environmental concentrations of specific carcinogens. (Author's abstract)
W91-11675

CARCINOGENESIS STUDIES IN RODENTS FOR EVALUATING RISKS ASSOCIATED WITH CHEMICAL CARCINOGENS IN AQUATIC FOOD ANIMALS.
National Inst. of Environmental Health Sciences, Research Triangle Park, NC.
J. Huff, J. Bucher, and R. Yang.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 127-132, 1991. 101 ref.

Descriptors: *Aquatic environment, *Bioassay, *Bioindicators, *Carcinogens, *Ecotoxicology, *Food chains, *Laboratory methods, *Literature review, *Public health, *Risk assessment, *Toxicology, *Water pollution effects, Biological studies, Boston Harbor, Data acquisition, Fish, Shellfish.

Public concern has been heightening recently concerning the amounts of carcinogens and other toxic chemicals found in fish and shellfish. Winter flounder taken from Boston Harbor was found to have visible cancer of the liver; winter flounder from outside the estuary had no liver lesions. Long-term chemical carcinogenesis studies could be easily and feasibly designed using laboratory rodents offered diets containing fish caught in polluted waters. Induced cancers in rodents would corroborate field observations in fish. Positive results from these studies would provide further evidence about potential human health hazards from eating substantial amounts of chemically contaminated fish. Nonetheless, fish and aquatic organisms should be viewed as environmental biological monitors of pollution or of potential human health hazards, and authorities responsible for assuring clean and safe rivers, bodies of water, and biota should give more attention to these valid biological indicators or sentinels of environmental pollution. Consequently fish and other sea creatures alone should serve as alarms regarding whether water areas constitute public health hazards. (Author's abstract)
W91-11676

EPIDEMIOLOGIC APPROACHES TO ASSESSING HUMAN CANCER RISK FROM CONSUMING AQUATIC FOOD RESOURCES FROM CHEMICALLY CONTAMINATED WATER.
Boston Univ., MA. School of Public Health.
For primary bibliographic entry see Field 5C.
W91-11678

MODEL STANDARDIZED RISK ASSESSMENT PROTOCOL FOR USE WITH HAZARDOUS WASTE SITES.
Pittsburgh Univ., PA. Dept. of Biostatistics.
For primary bibliographic entry see Field 5E.
W91-11679

ADVANTAGES OF DISTINGUISHING THE ACTIVE FRACTION IN BACTERIOPLANKTON ASSEMBLAGES: SOME EXAMPLES.
Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Inst. de Limonologie.
P. Dufour, J. P. Torreton, and M. Colon.
Hydrobiologia HYDRB8, Vol. 207, p 295-301, November 22, 1990. 2 fig, 3 tab, 31 ref.

Descriptors: *Aquatic bacteria, *Bacterial physiology, *Bioindicators, *Monitoring, Cell counting, Comparison studies, Ecotoxicology, Electron transport, Sampling, Thymidine.

The difficulty of distinguishing between active and dormant or dead bacterial cells is an important problem for the aquatic microbiologist. Active cells can be detected under the microscope by the presence of an intact electron transport system able to reduce the colorless INT (2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride) to an optically dense intracellular deposit. An improvement of this method has been applied to Lake Geneva and to a fish pond in the Ivory Coast. The portion of INT-reducing bacterial cells ranged from 1 to 71%, depending on place, depth, season and time of the day. In all cases, bacterial activity, determined by uptake of tritiated thymidine or carbon-14 labeled glucose, and frequency of dividing cells was better correlated with the number of INT-reducing cells than with the total number of cells, indicating that the counts of cells able to reduce INT have a better metabolic significance than total cell counts. Bacteria in mesotrophic Lake Geneva seemed to be limited by starvation and/or low temperature, while in the eutrophic Ivory Coast fish pond, a high percentage of active cells suggests an important contribution to grazing. This method is appropriate for a number of applications in ecophysiology and ecotoxicology. (Brunone-PTT)
W91-11715

SOME REMARKS ON THE PRESENCE OF ORGANIC PHOSPHATES IN SEDIMENTS.
Station Biologique de la Tour du Valat, Arles (France).
For primary bibliographic entry see Field 2K.
W91-11716

DISCREPANCIES BETWEEN A COLORIMETRIC AND ISOTOPIC METHOD FOR MEASURING NITRATE UTILIZATION IN NUTRIENT-DEPLETED WATERS: IMPLICATIONS FOR THE DESIGN OF EXPERIMENTAL PROTOCOLS IN NEW PRODUCTION STUDIES.
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 2H.
W91-11719

SELECTION OF METHODS FOR THE DETECTION AND ESTIMATION OF TRENDS IN WATER QUALITY.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5G.
W91-11734

PESTICIDES.
Lafayette Coll., Easton, PA. Dept. of Chemistry.
J. Sherma.
Analytical Chemistry ANCHAM, Vol. 63, No. 12, p 118R-130R, June 15, 1991. 1 tab, 440 ref.

Descriptors: *Laboratory methods, *Literature review, *Pesticides, *Pollutant identification, Dioxins, Gas chromatography, High performance liquid chromatography, Measuring instruments, Organic compounds, Polychlorinated biphenyls.

This review article covers the literature on pesticide analysis published or abstracted in the period between Dec. 1, 1988, and Dec. 1, 1990. The review is devoted mainly to methods for the determination of residues of pesticides in a wide variety of sample matrices. Some coverage is given to the analysis of related industrial chemicals, such as polychlorinated biphenyls and dioxins, but pesticide formulation analysis is not reviewed. An attempt was made to choose only the most important publications describing methodology, instrumentation, and applications that would be readily avail-

able to journal readers. Abstract citations are given for references from the more obscure journals and those not published in English. At the present time, gas chromatography (GC) is the primary method used for pesticide residue analysis, but applications of high performance liquid chromatography (HPLC), high performance thin layer chromatography (HPTLC), and supercritical fluid chromatography (SFC) have been increasing steadily. Areas in which significant advances and/or promise for future development in pesticide analysis were noted during the past 2 years include: capillary and 2-D capillary GC; capillary and microbore HPLC; increased application of HPLC detectors other than UV, such as the electrochemical detector; improved sample preparation employing solid phase extraction (PHE), on-line extraction and preconcentration methods, and supercritical fluid extractions (SFE); automated sample preparation and identification procedures; coupled methods such as GC/MS/MS, HPLC/MS, GC/FTIR, and radio-GC/MS; and methods involving enzyme inhibition. Most available residue methods have been devised for the analysis of only a single pesticide or pesticide class. Public health concerns require continued research aimed at extending the available multiclass, multiresidue methods, and finding new methods to include many more of the pesticides being used worldwide, as well as their polar and conjugated metabolites. While multiresidue methods are used by state and federal agencies to monitor foods and the environment, more specific analytical methods are used by the agrochemical companies, and contract laboratories hired by these companies, in support of pesticide registration and reregistration. (Lantz-PTT)
W91-11775

ENVIRONMENTAL ANALYSIS.
Ontario Ministry of the Environment, Rexdale. Lab. Services Branch.
R. E. Clement, M. L. Langhorst, and G. A. Eiceman.
Analytical Chemistry ANCHAM, Vol. 63, No. 12, p 270R-292R, June 15, 1991. 8 tab, 848 ref.

Descriptors: *Chemical analysis, *Environmental monitoring, *Laboratory methods, *Literature review, *Pollutant identification, Landfills, Organic compounds, Path of pollutants, Soil contamination, Trace levels, Water quality.

This review article covers developments in analytical chemistry as applied to environmental analysis for 1989-1990. A few articles appearing in 1988 are also included. Environmental analysis in its broadest context could include almost everything, but since reviews on water, air, and pesticide analysis have also been prepared, references to general air-quality and water-quality parameters, workplace/industrial hygiene issues, indoor air, and most herbicide/pesticides residue studies have been omitted. Guidelines, regulations, risk assessment, and modeling are not covered; nor are human levels and commercial food. The authors emphasize the detection and quantitation of trace metals and trace organics in real environmental matrices, including industrial emissions, landfill sites, spills and emergency response, ambient air, drinking/surface/groundwaters, marine samples, incinerators, mobile sources, soils, sediments, and some biota. Studies on background levels, development of environmental databases, the use of chemometric to analyze data, sampling, sample preparation, analyte separation, detection, and related topics are emphasized. The principal factors that make environmental analysis difficult are the range and complexity of sample types. Accordingly, this review is organized by matrix rather than analyte or method used. (Lantz-PTT)
W91-11776

WATER ANALYSIS.
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
For primary bibliographic entry see Field 2K.
W91-11777

GAS CHROMATOGRAPHIC SEPARATION OF CARBON DIOXIDE AND NITROUS OXIDE FOR STABLE ISOTOPIC ANALYSIS OF CARBON DIOXIDE.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7B.
W91-11804

ENVIRONMENTAL SURVEILLANCE DATA REPORT FOR THE FOURTH QUARTER OF 1988.
Oak Ridge National Lab., TN. Environmental and Occupational Safety Div.
For primary bibliographic entry see Field 5B.
W91-11848

1987 ENVIRONMENTAL MONITORING REPORT, SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NEW MEXICO.
Sandia National Labs., Albuquerque, NM. Environment, Safety, and Health Dept.
For primary bibliographic entry see Field 5B.
W91-11854

BIBLIOGRAPHY ON SAMPLING GROUND WATER FOR ORGANIC COMPOUNDS.
Geological Survey, Trenton, NJ. Water Resources Div.
J. Gibs, T. E. Imbrigiotta, and K. Turner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-564, 1990. 22p, 128 ref.

Descriptors: *Bibliographies, *Groundwater, *Organic compounds, *Sampling, *Water analysis, Groundwater pollution.

Selected references applicable to the collection and analysis of representative samples of groundwater for trace levels of organic compounds are presented in this report. The references are taken from lists used during four workshops on 'Sampling Ground Water for Organic Compounds' conducted by the U. S. Geological Survey in 1987 and 1988. The 128 references are organized into 12 topics: sampling devices, groundwater-sampling techniques, analysis of organic vapor(s) in soil, effects of materials on sorption and desorption, well drilling and installation, degradation of organic compounds, well purging, safety, well-network design, analytical methods for organic compounds, transport of organic compounds, and miscellaneous references. (USGS)
W91-11861

EXTENSION OF USEPA METHOD 531 FOR THE ANALYSIS OF SEVERAL CLASSES OF NITROGENOUS PESTICIDES IN GROUNDWATER BY POSTCOLUMN UV PHOTOLYSIS.
Florida Univ., Gainesville. Pesticide Research Lab.
B. M. Patel, and H. A. Moye.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-159418. Price codes: A05 in paper copy, A01 in microfiche. Final Report, July 1990. 58p, 9 fig, 20 tab, 35 ref. USGS Contract No. 14-08-0001-G1722.

Descriptors: *Aromatic pesticides, *Nitrogenous pesticides, *Pesticides, *Photochemistry, *Pollutant identification, Analytical techniques, Chromatography, Flow injection analysis, Fluorescence, Groundwater, Trace levels, Ultraviolet photolysis, Water analysis, Water chemistry.

The primary objective of this research was to expand the number of pesticides that can be analyzed in groundwater at trace levels by extending the USEPA Method 531 that now covers N-methyl carbamate and carbamoyl oxime pesticides to include several other classes of nitrogenous and aromatic pesticides by postcolumn ultraviolet (UV) photolysis. On-line photolysis with 2-watt mercury lamp in a Teflon tube knitted photoreactor was used to replace the conventional alkaline hydrolysis solution that is metered in postcolumn and the HPLC separations were optimized for several pesticides on reversed phase columns. Postcolumn on-line photolysis and/or photolysis followed by OPA-MERC reagent derivatization was sufficient for generation of fluorophores leading to enhanced fluorescence detection in HPLC for monitoring various pesticide residues in groundwater. The fluorescence detector sensitivity was optimized by selection of lamp type, photoreactor designs, photolytic solvents, and derivatization. The chromatographic resolutions and peak capacity were maximized by proper choice of analytical columns and elution solvent programming. Limits of detections less than 1 microg/L were obtained for several classes of nitrogenous and aromatic pesticides in groundwater by direct injection of 0.4 mL filtered water samples onto reversed phase analytical columns. The method was validated by determining percentage recoveries for various fortification levels, standard deviations for replicate analysis, and storage stability. The postcolumn UV photolysis and fluorometric detection provided sensitive, selective and direct analysis of many pesticides in groundwater at ppb concentrations that were, until now, not capable of being analyzed. (USGS)
W91-11873

NEW APPROACHES TO METAL SPECIATION IN NATURAL WATERS BASED ON MODIFIED AND MICROVOLTAMMETRIC ELECTRODES.
New Mexico State Univ., Las Cruces. Dept. of Chemistry
J. Wang.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-159467. Price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 251, August 1990. 16p, 16 ref. USGS State Project No. 1423607.

Descriptors: *Electrochemistry, *Heavy metals, *Metal speciation, *Pollutant identification, *Voltammetry, *Water analysis, *Water chemistry, Analytical techniques, Anode stripping voltammetry, Electrodes, Toxicity, Trace elements, Trace metals, Water measurement, Water quality.

The proliferation of heavy-metal contaminants in water has focused attention on their determination and characterization. The challenging research field of metal speciation (or the identification of a metal species) in natural waters, is in its early stages and numerous problems remain. This project resulted in more effective, reliable tools for speciation analysis of natural waters, thus offering a better understanding of the presence, toxicity, and transport of trace metals. Results could be included in future water quality legislation and used for measuring speciation-related water quality parameters. Specifically, advanced electrode technology was developed to overcome the organic-adsorption problem. Overcoming this problem allows for speciation studies in non-saline waters, like much of the water in New Mexico. Results also offered new information on size distribution of metal species, and expanded the technology toward additional trace elements. (Wang-NM St Univ.)
W91-11876

MOLECULAR STRUCTURE BASIS FOR THE MUTAGENICITY OF LIGNIN- AND HUMIC-DERIVED CHLOROFURANONES.
State Univ. of New York, Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 5D.
W91-11878

PRELIMINARY INVESTIGATION OF THE HYDROGEOLOGY AND CONTAMINATION IN THE AREA OF AN ABANDONED MANUFACTURED GAS PLANT IN ALBANY, GEORGIA.
Geological Survey, Doraville, GA.
M. J. Chapman, B. M. Gallaher, and D. A. Early.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4141, 1991. 56p, 24 fig, 10 tab. Project No. 4513-09700.

Descriptors: *Gasification, *Groundwater contamination, *Hydrocarbons, *Hydrogeology, *Organic compounds, Georgia, Groundwater, Metals, Surface geophysics, Unconsolidated sediments.

Prior to the introduction of natural gas pipelines in the 1950's, gas for lighting and heating in the United States was produced from coal or oil at local manufacturing gas plants. By-products and wastes generated at these plants commonly were disposed of on site. The major wastes, which include tar and oil residues and sludges, spent oxides, and ash materials, can consist of a complex mixture of hundreds of aromatic organic compounds as well as cyanides and metals. The U.S. Environmental Protection Agency lists many of these constituents as carcinogenic or as priority pollutants. An investigations was initiated in January 1989 in the vicinity of an abandoned manufactured gas plant in Albany, Georgia, to evaluate the hydrogeology and contamination of the area, and to test study techniques that may have application in similar situations. Geologic formations of interest to this investigation include, in descending order, unconsolidated sand and clay layers, the Ocala Limestone, and the Lisbon Formation. Surficial fill (man-made) overlies the sand and clay layers throughout the study area. High concentrations of aromatic hydrocarbons and various metals were detected in the unconsolidated sediments in the vicinity of the abandoned gas plant. Maximum concentrations of hydrocarbons detected in sediment samples included 560,000 microg/kg naphthalene, 73,000 microg/kg ethylbenzene, 28,000 microg/kg benzene, and 24,000 microg/kg toluene. These higher concentrations of hydrocarbons were present in the vicinity of the former gas holding tanks. In that area, contamination extends at least to the depth of the contact between the unconsolidated sand and clay layers and the Ocala Limestone. (USGS)
W91-11935

ENVIRONMENTAL GENOTOXITY MONITORING USING SALMONELLA TYPHMURIUM STRAINS AS INDICATOR SYSTEM.
Postgraduate Medical and Pharmaceutical Institute, 100 05 Prague, Czechoslovakia.
M. Cerna, V. Hajek, E. Stejskalova, L. Dobias, and Z. Zudova.
Science of the Total Environment STENDL, Vol. 101, No. 1/2, p 139-147, January 1991. 4 fig, 6 tab, 13 ref.

Descriptors: *Bioindicators, *Chemical wastewater, *Drinking water, *Environmental monitoring, *Genotoxicity, *Mutagenicity, *Salmonella, *Surface water, Czechoslovakia, Industrial pollution, Organic pollutants, Wastewater treatment facilities, Water pollution sources, Water treatment.

Testing for mutagenic activities in drinking water and surface water or in chemical waste discharges with the aid of Salmonella systems is applicable in the search for genotoxic agents in the environment and also as a base for determining effective regulatory activities. The Czechoslovak Hygiene Service has accepted the methodology described to test drinking water mutagenicity. Seventy organic extracts of drinking water samples were analyzed; fifty-four samples were found to be mutagenic. The quality of water sources prior to treatment operations is decisive for the final quality of drinking water supplies. Surface water drinking water sources were generally more mutagenic that groundwater sources. River water sampling tests indicated a marked contamination mutagens due to discharge of chemical wastes from a plant that had no wastewater treatment facilities of its own. (Feder-PTT)
W91-11975

SPATIAL VARIATIONS OF SAPWOOD CHEMISTRY WITH SOIL ACIDITY IN APPALACHIAN FORESTS.
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 5C.
W91-12008

CHARACTERIZATION OF EXOPOLYMERS OF AQUATIC BACTERIA BY PYROLYSIS-MASS SPECTROMETRY.
Harvard Univ., Cambridge, MA. Lab. of Microbial Ecology.
For primary bibliographic entry see Field 2K.
W91-12010

DNA SYNTHESIS AND TRITIATED THYMIDINE INCORPORATION BY HETEROTROPHIC FRESHWATER BACTERIA IN CONTINUOUS CULTURE.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 2H.
W91-12012

DIRECT DETERMINATION OF MOLECULAR HYDROGEN SULFIDE IN SEWAGE EFFLUENTS.
Ministry of Public Health, Safat (Kuwait).
For primary bibliographic entry see Field 5D.
W91-12038

INCREASED ABUNDANCE AND GROWTH OF THE SUSPENSION-FEEDING BIVALVE CORBULA GIBBA IN A SHALLOW PART OF THE EUTROPHIC LIMFJORD, DENMARK.
National Environmental Research Inst., Charlottenlund (Denmark).
J. N. Jensen.
Netherlands Journal of Sea Research NJSRBA, Vol. 27, No. 1, p 101-108, December 1990. 4 fig, 2 tab, 33 ref.

Descriptors: *Animal growth, *Bioindicators, *Bivalves, *Denmark, *Estuaries, *Eutrophication, *Fjords, *Population density, *Water pollution effects, Biomass, Intertidal areas.

The abundance, growth and production of Corbula gibba have been studied by intensive sampling over a 2-year period in a shallow part of the eutrophied Limfjord (Denmark). Size-frequency distributions and growth marks on the shells were used to follow successive cohorts over time. The abundance of Corbula gibba was high, the highest density found in 1-mm sieve samples (approximately 53,000) being one order of magnitude higher than previously recorded. The analysis of samples sieved through 250 micron sieves revealed that settling took place in August. The mortality of newly settled individuals was high, followed by low and constant mortality during the following winter. The growth of C. gibba was fast compared with records from the Irish Sea and the Sound and the specimens reached a mean size of 6 to 7 mm one year after settlement. It is suggested that the between-year-variation in growth rate was caused by variable frequencies of wind-induced resuspension of settled organic matter. The production of C. gibba varied between stations but was generally high (mean: 26.8 g AFDW/yr/sq m) compared with previous records from subtidal areas. The P/B ratio is among the highest recorded (mean: 4.2/yr). Growth seems to be higher at present than during the first part of this century, probably due to the increased eutrophication of the Limfjord. It is suggested that growth rate may be a good complement to the use of total abundance and biomass in monitoring, as the latter parameters are more variable due to stochastic events such as sampling variance and inter-seasonal variations in settlement success caused by physical factors. (Author's abstract)
W91-12069

USE OF WATER HYACINTHS TO DETERMINE TRACE METAL CONCENTRATIONS IN THE TROPICAL MORICHAL LARGO RIVER, VENEZUELA.
Instituto Venezolano de Investigaciones Cientificas, Caracas. Centro de Quimica.
H. Schorin, Z. A. de Benzo, C. Bastidas, M. Velosa, and E. Marcano.
Applied Geochemistry APPGEY, Vol. 6, No. 2, p 195-200, 1991. 1 fig, 5 tab, 14 ref.

Descriptors: *Bioaccumulation, *Bioindicators, *Morichal Largo River, *Pollutant identification, *Trace metals, *Water hyacinth, Baseline studies, Cadmium, Chromium, Copper, Heavy metals, Lead, Nickel, River sediments, Sand, Tropical regions, Venezuela, Zinc.

Water, sediments and water hyacinths (Eichhornia crassipes) from the Morichal Largo River, Venezuela, were analyzed for various major and trace elements in order to obtain background geochemical data. The river water itself was found to have low metal concentrations. The sediments were comprised of very fine to medium-grained quartz sand with only traces of clay minerals capable of reflecting contamination, as well as detrital minerals containing titanium, iron and zirconium. Concentrations of chromium, nickel, copper, zinc, cadmium and lead were determined for the leaves and roots of the water hyacinths. Results indicate that these plants are efficient concentrators of various metals and should be useful in assessing possible future metal pollution in the river. (Author's abstract)
W91-12133

FISH BILE AS A TOOL FOR MONITORING AQUATIC POLLUTANTS: STUDIES WITH RADIOACTIVELY LABELLED 4,5,6-TRICHLOROGUAIACOL.
Stockholm Univ. (Sweden). Wallenberg Lab.
C. A. Wachtmeister, L. Forlin, K. C. Arnoldsson, and J. Larsson.
Chemosphere CMSHAF, Vol. 22, No. 1/2, p 39-46, 1991. 2 fig, 2 tab, 27 ref.

Descriptors: *Bile, *Bioindicators, *Phenols, *Pulp wastes, *Radiochemical analysis, *Sculpin, *Trichloroguaiacol, Bioassay, Biochemistry, Fish physiology, Metabolism, Path of pollutants, Radioactive tracers.

In bleached pulp effluent, large amounts of chlorinated phenolic compounds (e.g., chlorinated phenols, catechols and guaiacols) are present. Many of these compounds are relatively polar and do not appear to be persistent in fish. Nevertheless, they pose a potential threat to the environment because very large amounts are released. Fourhorn sculpin were exposed to 0.2 or 0.05 micrograms/L of tritium labeled 4,5,6-trichloroguaiacol (4,5,6-TCG) under continuous water-flow conditions for 33 days. The phenol was metabolized to glucuronide and sulfate esters, and an increase in bile radioactivity was observed, indicating that the compound and its metabolites were efficiently eliminated. By day 6, levels in the bile had reached an approximate steady state. During the last week of exposure bile radioactivity decreased markedly, probably as a result of a drop in water temperature. The relative distribution of bile radioactivity among individual components was studied using high pressure liquid chromatography. Based on these results, it was calculated that under steady state conditions during 6 to 20 days, the average ratio of concentration of 4,5,6-TCG with metabolites in bile to concentration of free phenol in brackish water (bBCF) was 65,000 +/-15,000 with a variance of $< 25\%$ at two exposure levels. Based on the high bBCF values obtained, it appears that bile from stationary fish can be effectively used to monitor the exposure of fish to aquatic pollutants. (Author's abstract)
W91-12138

COMPARISON OF METHODS FOR THE EXTRACTION OF PENTACHLOROPHENOL FROM AQUEOUS AND SOIL SYSTEMS.
Nova Scotia Agricultural Coll., Truro. Environmental Microbiology Lab.
A. J. Wall, and G. W. Stratton.
Chemosphere CMSHAF, Vol. 22, No. 1/2, p 99-106, 1991. 2 tab, 28 ref.

Descriptors: *Biodegradation, *Chemical analysis, *Cleanup operations, *Pentachlorophenol, *Sampling, *Separation techniques, *Water analysis, Biological treatment, Comparison studies, Site remediation.

Numerous studies have been undertaken to examine the efficacy of using bacteria and fungi to

degrade PCP in situ. In all of these experiments, PCP must first be extracted from soil or water in order to quantitate biodegradation rates. The efficiency of extraction of pentachlorophenol (PCP) from both soil and a liquid bacterial growth medium was evaluated using a standard extraction procedure and three alternative methods for each system (the standard acid/base/neutral extraction, liquid/liquid extraction, and sonication extraction and column extraction). Significant differences in recovery efficiency and time/cost factors were noted in both test systems. In the bacterial medium, a column extraction procedure was significantly more effective than the standard method. In addition to eliciting the highest percent recovery at all PCP concentrations tested, column extraction was also the least technically complex method, had the lowest solvent requirement, and was the most rapid extraction procedure examined. In soil, the alterative procedures were as effective as the standard method at extracting PCP (all above 94% recovery), but offered substantial time and cost savings. (Author's abstract)
W91-12141

COMPARISON OF PCB QUANTITATION METHODS: RE-ANALYSIS OF ARCHIVED SPECIMENS OF HERRING GULL EGGS FROM THE GREAT LAKES.
Canadian Wildlife Service, Ottawa (Ontario).
R. Turle, R. J. Norstrom, and B. Collins.
Chemosphere CMSHAF, Vol. 22, No. 1/2, p 201-213, 1991. 4 fig, 2 tab, 17 ref.

Descriptors: *Aroclors, *Eggs, *Great Lakes, *Gulls, *Pollutant identification, *Polychlorinated biphenyls, *Statistical analysis, Analytical methods, Biological samples, Chemical analysis, Data quality control, Temporal distribution, Tissue analysis.

Eggs have been collected from colonies of Herring Gulls (Larus aegentatus) throughout the Great Lakes since 1970, and analyzed as a means of assessing trends in levels of organochlorine contaminants. Polychlorinated biphenyls (PCBs) were originally determined by packed-column gas chromatography-ECD (electron capture detector) as Aroclor 1254/1260 1:1 equivalents. Since 1986, 41 individual congeners have been determined and summed to obtain their total (sumPCB). In order to relate the new and old data and remove discontinuities due to method improvements, representative samples of pooled gulls' eggs from the 1970s and 1980s were retrieved from a specimen bank and reanalyzed for individual PCB congeners. Samples were selected that were representative of the monitoring colonies for each lake and at approximately four year intervals. Conversion factors from Aroclor 1254/1260 1:1 to sumPCB were 0.450 for Lake Superior, 0.484 for Lake Huron, 0.444 for Lake Erie and 0.461 for Lake Ontario. Patterns of PCB congeners in Herring Gull eggs do not appear to have varied significantly among lakes in early years when sumPCB levels were above 40 mg/kg, but in more recent years there is more variability among lakes. Results probably indicate that the most important congener changes in the 1970s and early 1980s resulted from input of Aroclor mixtures into the ecosystem, rather than selective changes due to differences in physicochemical properties of individual congeners. (Author's abstract)
W91-12143

MONITORING OF THE OVERALL PESTICIDE TOXICITY OF RIVER WATER TO AQUATIC ORGANISMS USING A FRESHWATER SHRIMP, PARATYA COMPRESSA IMPROVISA.
National Inst. for Environmental Studies, Tsukuba (Japan). Regional Environment Div.
S. Hatakeyama, H. Shiraishi, and Y. Sugaya.
Chemosphere CMSHAF, Vol. 22, No. 1/2, p 229-235, 1991. 2 fig, 10 ref.

Descriptors: *Bioassay, *Bioindicators, *Pesticide toxicity, *River shrimp, *Toxicity, *Toxicology, *Water pollution effects, Fenitrothion, Fenthion, Fungicides, Hazard assessment, Insecticides, Japan, Mortality, Organophosphorus pesticides, Path of pollutants, Rice fields, Stream pollution.

River water samples were collected from four sampling stations in three small rivers, the Ono, Hanamuro, and Bizen Rivers in Ibaraki Prefecture, Japan, from July 1988 to March 1989; the three rivers sampled were surrounded by paddy fields. Bioassays were conducted using the freshwater shrimp, Paratya compressa improvisa, to establish the variation in overall toxicity of the river waters to aquatic organisms. The 4-day mortality of the shrimp increased to 100% for several days after aerial spraying of insecticides and fungicides conducted between late July and early August. However, mortality gradually decreased to only a few percent by the end of August and showed similar low values until the end of the survey in March 1989. The high mortality of the shrimp is attributed largely to the pesticides (fenitrothion, fenthion, and/or BPMC (an organophosphorus insecticide)), although the contribution of herbicides and fungicides is unclear at the present time. Bioassay results suggest that the habitat of this shrimp has been severely restricted by pesticide pollution, at least in small rivers and ditches surrounding paddy fields which received pesticide applications. The species can only now be found in very restricted environments, such as ponds or small streams not polluted with pesticides. The high shrimp mortality suggested the existence of other toxic pesticides which were overlooked in routine analysis. (Author's abstract)
W91-12144

LEVELS AND PATTERNS OF PCDD AND PCDF CONTAMINATION IN FISH, CRABS, AND LOBSTERS FROM NEWARK BAY AND THE NEW YORK BIGHT.
Umea Univ. (Sweden). Inst. of Environmental Chemistry.
For primary bibliographic entry see Field 5B.
W91-12145

CHEMICAL CHARACTERIZATION OF POLYCYCLIC AROMATIC HYDROCARBON MIXTURES IN UNCONTROLLED HAZARDOUS WASTE DUMPS.
Centro de Investigacion y Desarrollo, Barcelona (Spain). Dept. of Environmental Chemistry.
J. Villanueva, A. Rosell, J. O. Grimalt, and A. Navarro.
Chemosphere CMSHAF, Vol. 22, No. 3/4, p 317-326, 1991. 3 fig, 1 tab, 25 ref.

Descriptors: *Chemical analysis, *Hazardous wastes, *Pollutant identification, *Polycyclic aromatic hydrocarbons, *Waste dumps, *Waste identification, Coal tars, Naphthalenes, Oil, Organic compounds, Soil analysis, Spain.

The leaching of organic pollutants from an uncontrolled hazardous waste dump (Nervion River, northern Spain) produced severely contamination of the nearby aquifers. Samples obtained by rotary drilling and continuous core extraction (10 m), were analyzed by gas chromatography (GC) alone, and GC coupled with mass spectrometry (GC-MS) for solvent extracts. Three types of source materials, industrial naphthalene mixtures, coal tars and lubricating oils, were determined to be a source of organic contamination from the waste sites. Naphthalene mixtures found in site 1, were composed of a mixture of polycyclic aromatic hydrocarbons (PAH) predominated by naphthalene, with methylnaphthalenes, acenaphthylene, dibenzofuran, fluorene and phenanthrene as secondary major products. Coal tars were found in all site 2 samples; specifically phenanthrene, fluoranthrene and pyrene, with other unsubstituted PAH as significant secondary constituents. Lubricating oil mixtures were found in the upper 2 meter core sections of site 2, and were characterized by a highly unresolved complex mixture containing hopanes and steranes. (VerNooy-PTT)
W91-12147

GLACIAL ICE COMPOSITION: A POTENTIAL LONG-TERM RECORD OF THE CHEMISTRY OF ATMOSPHERIC DEPOSITION, WIND RIVER RANGE, WYOMING.
Geological Survey, Cheyenne, WY.
For primary bibliographic entry see Field 2C.
W91-12237

ENZYME IMMUNOASSAYS FOR THE DETERMINATION OF S-TRIAZINES IN WATER SAMPLES: TWO INTERLABORATORY TESTS.
Fachhochschule Weihenstephan, Freising (Germany, F.R.). Dept. of Botany.
B. Hock.
Analytical Letters ANALBP, Vol. 24, No. 4, p 529-549, April 1991. 11 fig, 5 tab, 11 ref.

Descriptors: *Analytical methods, *Immunoassay, *Pesticides, *Pollutant identification, *Triazines, *Water analysis, Atrazine, Enzyme immunoassay, Interlaboratory variation, Laboratory methods, Organic compounds, Variability, Water quality monitoring.

Interlaboratory tests were conducted for the quantitative determination of s-triazines in water samples by enzyme immunoassay. Ten samples of groundwater, drinking water, and surface water with and without added s-triazines were analyzed by 13 laboratories using a number of different enzyme immunoassays. Compared with gas chromatographic/mass spectrometric methods, enzyme immunoassays resulted in an underestimation of total s-triazine values. Also, a high degree of interlaboratory variation in s-triazine results by immunoassay was observed. Twelve laboratories participated in a second interlaboratory test using three of the most promising enzyme immunoassays from the first test. All immunoassays correctly identified the zero sample (drinking water). In general, the same results were obtained for identical samples. One of the immunoassays was found to yield accurate results for atrazine concentration while the other two tests were judged to be more suitable for the group determination of s-triazines. Recommendations for the use of enzyme immunoassays for the determination of pesticides in water samples include the following: the use of trained personnel in certified laboratories; the use of at least six calibration points, four of which are in the working range; consideration of matrix effects; and quadruplicate determinations per sample. Under these conditions, immunoassays are considered rapid and relatively simple tests for the determination of pesticides in water samples. (MacKeen-PTT)19 Jun 91
W91-12268

DESMIDS AS INDICATORS OF WATER QUALITY IN THE MARRAKECH REGION (MOROCCO) (DESMIDIEES EN TANT QU'INDICATEURS DE LA QUALITE DES EAUX DANS LA REGION DE MARRAKECH (MAROC)).
Cadi Ayyad Univ., Marrakech (Morocco). Dept. de Biologie.
For primary bibliographic entry see Field 2H.
W91-12270

DETERMINATION OF TECHNETIUM-99 IN ENVIRONMENTAL SAMPLES BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY.
Tsukuba Univ. (Japan). Dept. of Chemistry.
S. Morita, C. K. Kim, Y. Takaku, R. Seki, and N. Ikeda.
International Journal of Radiation Applications & Instrumentation. A, Appl. Radiation & Isotopes ARISEF, Vol. 42, No. 6, p 531-534, 1991. 2 fig, 4 tab, 13 ref.

Descriptors: *Analytical methods, *Environmental monitoring, *Pollutant identification, *Radioisotopes, *Technetium, Chemical analysis, Detection limits, Environmental pollution, Inductively coupled plasma mass spectrom, Sediments, Soil samples.

Technetium-99 (99-Tc) was measured in environmental samples by inductively coupled plasma mass spectrometry (ICP-MS). The calibration curve for 99-Tc was linear in the range of 2.2-55 pg/ml. To determine 99-Tc by ICP-MS, 99-Tc has to be completely purified from 99-Ru, which has a mass abundance of 12.7%. Samples were pretreat-

ed with hydrogen peroxide and extracted with cyclohexane to remove ruthenium. Soil samples from the Okuetsu plateau, Fukui Prefecture, and estuarine sediments from the Irish Sea were analyzed the method, yielding chemical recoveries of 42-63%. The results were in good agreement with those obtained by the liquid scintillation counting method with a relative deviation of 2-3%. The detection limit for the ICP-MS method is 1.1 mBq/ml (1.73 pg/ml). The method is recommended for the determination of other low-level, long-lived radionuclides in environmental samples. (MacKeen-PTT)
W91-12276

OPTIMUM GEOMETRY OF RADIOACTIVE AQUEOUS SAMPLE CONTAINER FOR MEASUREMENT WITH A GERMANIUM DETECTOR.
National Tsing Hua Univ., Hsinchu (Taiwan). Inst. of Nuclear Science.
C. Chung, C. J. Lee, and S. F. Shiee.
International Journal of Radiation Applications & Instrumentation. A, Appl. Radiation & Isotopes ARISEF, Vol. 42, No. 6, p 541-545, 1991. 5 fig, 1 tab, 9 ref. National Science Council of the Republic of China contract NSC78-0413-E007-09.

Descriptors: *Analytical methods, *Environmental monitoring, *Instrumentation, *Measuring instruments, *Pollutant identification, *Radioactivity, *Radioisotopes, *Sampling, Detection limits, Gamma radiation, Germanium, Water samples.

High-resolution gamma-ray spectra of radioactive aqueous samples with volumes of 0.1-4.0 L, were measured using a 20% relative efficiency germanium detector. A total of 308 spectra, covering the photoenergy range of 50-1500 keV, were sorted and analyzed with various sample geometries. The optimum dimensions of a Marinelli-like container were obtained to maximize the count rate of aqueous samples up to 4 L. The volume of the ring surrounding the lateral surface of the hyperpure germanium (HPGe) detector is the dominant contribution to the radioactive measurement, although its importance decreases as the total volume increases. For aqueous samples <1 L, the optimum geometry holds when the source thickness in the axial and radial directions of the HPGe crystal are equal. The practical limit of sample size is estimated to be 10 L for gamma assay to 1500 keV. (MacKeen-PTT)
W91-12277

RISK ASSESSMENT AND CONTROL OF WATERBORNE GIARDIASIS.
University of South Florida, Tampa. Dept. of Environmental and Occupational Health.
For primary bibliographic entry see Field 5F.
W91-12283

CONSEQUENCES OF PH MEASUREMENT ERRORS.
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV. Environmental Programs Office.
For primary bibliographic entry see Field 7B.
W91-12310

DEFINED SUBSTRATE TECHNOLOGY METHOD FOR RAPID AND SPECIFIC SIMULTANEOUS ENUMERATION OF TOTAL COLIFORMS AND ESCHERICHIA COLI FROM WATER: COLLABORATIVE STUDY.
Yale Univ., New Haven, CT. School of Medicine.
S. C. Edberg, M. J. Allen, and D. B. Smith.
Journal-Association of Official Analytical Chemists JANCA2, Vol. 74, No. 3, p 526-529, May/June 1991. 2 tab, 15 ref.

Descriptors: *Bacterial analysis, *Coliforms, *Escherichia coli, *Microbiological studies, *Pollutant identification, *Water analysis, Comparison studies, Culturing techniques, Fermentation.

The defined substrate technology (DST) method is a reagent system that simultaneously enumerates total coliforms and Escherichia coli directly from a water sample. Noncoliform bacteria are suppressed and cannot metabolize the indicator nutrients. Nine laboratories participated in a field evaluation of the method, which covered a wide range of surface and subsurface water source and water-processing systems. The DST system was compared to multiple-tube fermentation (MTF) (quantitative) and presence-absence (P-A) (qualitative) Standard Methods formats. A comparison of water samples from natural sources using the most probable number (MPN) procedure showed that the DST test was equivalent to the MTF test. The DST and P-A procedures agreed with each other in 94% of the water samples analyzed. Specificity of the DST method was established by subculturing a species consistent with a total coliform of E. coli from each positive tube. Eight laboratories participated in a collaborative study of the method, with each laboratory receiving 3 concentrations of E. coli. The DST test was inoculated from a split sample of each bacterial density in parallel with Standard Methods brilliant green lactose broth. Statistical analysis for repeatability and reproducibility showed the DST system to be equivalent to currently used standard methods. (Author's abstract)
W91-12352

DETERMINATION OF MONOCYCLIC AND POLYCYCLIC AROMATIC HYDROCARBONS IN FISH TISSUE.
National Fisheries Contaminant Research Center, Columbia, MO.
J. A. Lebo, J. L. Zajicek, T. R. Schwartz, L. M. Smith, and M. P. Beasley.
Journal-Association of Official Analytical Chemists JANCA2, Vol. 74, No. 3, p 538-544, May/June 1991. 1 fig, 3 tab, 33 ref.

Descriptors: *Chemical analysis, *Fish, *Hydrocarbons, *Laboratory methods, *Pollutant identification, *Polycyclic aromatic compounds, *Tissue analysis, Adsorption, Detection limits, Gas chromatography, Lipids, Sample preparation, Silicates, Solvents.

An analytical method was developed in which fish tissue can be analyzed for neutral monocyclic and polycyclic aromatic hydrocarbons (AHs), and aromatic sulfur heterocycles (ASHs), by capillary column gas chromatography (CGC) with photoionization detection. The sample enrichment procedure includes saponification with aqueous KOH, acidification of the digestates, and extraction of the aromatic compounds into cyclopentane-dichloromethane. Adsorption chromatography on tandem segments of potassium silicate and silica gel removed 99% of the coextracted lipid. Final enrichment by gel permeation chromatography eliminated residual biogenic material and potentially interfering alkanes. Relatively volatile monoaromatics are included among the analytes because of the efficiency of the complementary enrichment steps, the use of small quantities of only low-boiling solvents, and the selectivity of the detector. Most targeted compounds (AHs ranging in size from C3-alkylbenzenes through benzo(ghi)perylene and ASHs within the same size range) can be determined in 5 g (wet weight) samples of fish tissue at concentrations as low as 20 ng/g. The handling of samples under gold light increased the precision of recovery of the larger AHs. (Author's abstract)
W91-12353

DETERMINATION OF MCPA, BROMOXYNIL, 2,4-D, TRIFLURALIN, TRIALLATE, PICLORAM, AND DICLOFOP-METHYL IN SOIL BY GC-MS USING SELECTED ION MONITORING.
Enviro-Test Labs., Edmonton (Alberta).
G. W. Bruns, S. Nelson, and D. G. Erickson.
Journal-Association of Official Analytical Chemists JANCA2, Vol. 74, No. 3, p 550-553, May/June 1991. 2 fig, 2 tab, 4 ref.

Descriptors: *Chemical analysis, *Gas chromatography, *Herbicides, *Mass spectrometry, *Pollutant identification, *Soil analysis, Bromoxynil, Detection limits, Diclofop-methyl, Dioxins, Ions, Organic compounds, Picloram, Standard deviation, Triallate, Trifluralin.

A double space extraction procedure was developed to simultaneously determine neutral herbicides (trifluralin, diclofop-methyl, and triallate) and acid herbicides (MCPA, 2,4-D, bromoxynil, and picloram) in soil. The method uses capillary column gas chromatography (GC) and mass spectrometry (MS) detection, with a high degree of confidence, in the interpretation of herbicides in many soil types to the 0.003 ppm level. Detection limits at these low levels are possible because extracts can be concentrated by a factor of 50 with few of the coextractive interferences evident in chromatography. Recovery data are excellent for both groups of herbicides (81.5-97.8% average); relative standard deviations vary from 15% to 23% because of the larger response variation using GC/MS detection. The identification and quantitation of herbicides at 0.01 ppm in complex organic soil matrices can be achieved by applying selected ion monitoring (SIM) techniques. With GC/MS in the SIM, there is not only a retention time for compound identification, but for 2 or more confirmation ions and their ratios as well. Ratios of confirmation ions (RIAs) should be within 20% of the RIA for the standard compound. This 20% criterion is also used in the identification of dioxins by low resolution MS. (Doria-PTT)
W91-12354

INHIBITION OF AGGREGATION-FACTOR-INDUCED RAS GENE EXPRESSION IN THE SPONGE GEODIA CYDONIUM BY DETERGENT-POLLUTED SEAWATER: A SENSITIVE BIOLOGICAL ASSAY FOR LOW-LEVEL DETERGENT POLLUTION.
Institut fur Physiologische Chemie, Abteilung Angewandte Molekularbiologie, Univeritat, Duesbergweg 6, W-6500 Mainz, Germany.
D. Ugarkovic, B. Kurelec, A. Robitzki, W. E. G. Muller, and H. C. Schroder.
Marine Ecology Progress Series MESEDT, Vol. 71, No. 3, p 253-258, April 30, 1991. 2 fig, 2 tab, 39 ref.

Descriptors: *Bioassay, *Bioindicators, *Detergents, *Genetics, *Sponges, *Water pollution effects, Aquatic animals, Coelenterates, Genetic pollution, Physiological ecology, Toxicity, Water pollution.

The ras (rat sarcoma) gene product of the marine sponge Geodia cydonium mediates the proliferative response of the sponge cells after binding the Geodia aggregation factor to its specific membrane-bound receptor. It has been previously determined in field experiments that ras gene expression in regenerating sponge cubes reacted strongly to genotoxic xenobiotics in seawater. It was also shown that reaggregation of dissociated G. cydonium cells could be induced by the aggregation factor. Expression of ras gene in the cells, caused by the aggregation factor, was inhibited by detergents at concentrations in a pollution-relevant range. The incubation of single sponge cells in the presence of aggregation factor together with the anionic detergent sodium dodecyl sulfate or the cationic detergent cetyltrimethylammonium bromide at concentrations from 0.1 nanogrm/ml 10 microgm/mL, resulted in a reduction of ras mRNA levels by about 50% at 1.0 nanogm/mL sodium dodecyl sulfate/mL and 10 nanogm cetyltrimethylammonium bromide/mL (10 hour incubation period), and in an inhibition of aggregate formation by about 50 at 10 nanogm sodium dodecyl sulfate/ml and 0.1 nanogm cetyltrimethylsammonium/mL (2 hour incubation period). Results showed that aggregation-factor-caused ras gene expression in dissociated G. cydonium cells was a sensitive indicator model for studying detergent pollution of seawater in a concentration range comparable to, or lower than, that found in marine coastal areas. (Author's abstract)
W91-12389

CONTINUOUS FLOW THIN-LAYER HEADSPACE (TLHS) ANALYSIS: II. SPECTROPHOTOMETRIC DETERMINATION OF VOLATILE ORGANIC HALOGENS (VOX) IN WATER.
Gdansk Technical Univ. (Poland). Inst. of Inorganic Chemistry and Technology.
E. Kozlowski, E. Sienkowska-Zyskowska, and T. Gorecki.

Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 339, No. 12, p 882-885, 1991. 5 fig, 2 tab, 7 ref. Grant CPBP 01.17.

Descriptors: *Analytical methods, *Halogens, *Pollutant identification, *Spectrophotometry, *Thin-layer headspace analysis, *Water analysis, Chemical interference, Continuous flow analysis, Halogenated organic compounds, Sulfur oxides, Volatile organic compounds, Wastewater analysis.

The volatile sulfur levels in tap water usually are low, so it is rarely necessary to remove sulfur oxides from the mineralization products when using thin-layer headspace (TLHS) analysis. However, in natural waters, and particularly in wastewaters, the situation can be totally different. A new method was developed for the continuous determination of volatile organic halogen (VOX) in water. It is based on isolation of the volatile analytes (VA) from the aqueous sample by means of the TLHS technique, mineralization of the VA in an empty quartz tube, and subsequent determination of the formed halogen ions absorbed in a liquid sorbent by means of an indirect spectrophotometric method using the iron thiocyanate complex. The method proved to be selective. No interferences of other elements have been found at the levels encountered in practice. Because of this fact and the sensitivity of the method (around 0.1 microgram/gram), the method is well suited for the determination of VOX level in wastewaters. The theory of continuous flow TLHS analysis has been further developed and mathematical analysis of the derived general equation for the concentration of the VA in the liquid sorbent has been done. (Author's abstract)
W91-12439

COMPARISON OF LABORATORY BATCH METHODS AND LARGE COLUMNS FOR EVALUATING LEACHATE FROM MONOFILLED SOLID WASTES.
Radian Corp., Austin, TX.
D. R. Jackson, and D. L. Bisson.
Journal of the Air & Waste Management Association JAWAEB, Vol. 40, No. 11, p 1514-1521, November 1990. 3 fig, 7 tab, 5 fig. US EPA Contract 68-03-3248.

Descriptors: *Laboratory methods, *Leachates, *Monitoring, *Solid wastes, *Wastewater analysis, Comparison studies, Electroplating, Incineration, Mine wastes, Municipal wastes.

Analyte concentrations in aqueous leachates from polyethylene tanks filled with five different solid wastes were compared with those in extracts from five laboratory batch procedures. Solid wastes used included: electroplating sludge, electric arc furnace dust, paint incinerator ash, mine tailings, and municipal refuse incinerator ash. Batch extraction procedures used to extract solid wastes included Monofilled Waste Extraction Procedure (MWEP), USEPA Extraction Procedure (EP), Ham Procedure C (HAM-C), Acetate Buffer Extraction Procedure (ABEP), and Saturated Paste Procedure (PASTE). Analyte concentrations in leachate from the large columns were reproducible and characteristic of each solid waste. In most instances, analytes in column leachate reached a peak concentration at a liquid-to-solid ratio of 1:1 followed by a gradual to rapid decrease with continued leaching. Analyte concentrations found in large column leachate were related qualitatively to those found in extracts from the batch procedures that used deionized water as the extraction medium (i.e., MWEP, HAM-C, and PASTE). Batch extraction procedures using leaching medium containing acetic acid (i.e., EP) or sodium acetate buffer (i.e, ABEP) generally did not reflect analyte concentrations in leachate from the large columns. These results suggest that batch extraction procedures using acetic acid or acetate buffer are less effective for assessing the leachability of monofilled wastes that extraction methods using deionized water as the extraction fluid. (Author's abstract)
W91-12450

STUDIES ON THE ECOLOGY OF AQUATIC BACTERIA OF THE LOWER NIGER DELTA: POPULATIONS OF VIABLE CELLS AND PHYSIOLOGICAL GROUPS.
Port Harcourt Univ. (Nigeria). Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W91-12473

EVALUATION OF CHROMATOGRAPHIC AND SPECTROSCOPIC METHODS FOR THE ANALYSIS OF PETROLEUM-DERIVED COMPOUNDS IN THE ENVIRONMENT.
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
G. Morel, O. Samhan, P. Litherathy, H. Al-Hashash, and L. Moulin.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 339, No. 10, p 699-715, April 1991. 9 fig, 3 tab, 39 ref.

Descriptors: *Chromatography, *Hydrocarbons, *Oil spills, *Petroleum products, *Pollutant identification, *Spectroscopy, *Water analysis, Aromatic compounds, Kuwait, Laboratory methods, Performance evaluation, Sediments, Tissue analysis.

Analytical protocols were adapted for the study of hydrocarbons at the trace level in the environment. Various samples, including sediments and biota, were collected in Kuwait, treated according to the protocol and analyzed by chromatographic and spectroscopic methods (i.e., synchronous scanning fluorescence spectroscopy (SSFS), high-performance liquid chromatography (HPLC) on C18 reversed-phase and NH2 normal-phase columns with UV and fluorescence detectors; gas chromatography (GC) on fused-silica capillary columns with flame ionization detector (FID), mass spectrometer (MS), and flame photometric detector (FPD); and high-resolution molecular spectrofluorimetry in Shpol'skii matrix at 10K (HRSS). The different methods yielded complementary information. SSFS was used for fast evaluation and preliminary assessment of oil pollution during extended programs. It permitted sample detection for deeper analyses, but needed special care in clean-up when applied to biota. GC/FID was used to analyze saturated and ethylenic compounds. GC/FPD was difficult to use with sediment samples and yielded little information on biota samples, but it did confirm high oil contamination in some samples. HPLC on a normal-phase column with UV and fluorescence detectors was useful for the fractionation of samples and for the separation of different families of aromatic compounds according to aromatic carbon number. GC/MS was used to quantify polycyclic aromatic hydrocarbons (PAHs) of less than four cycles but was not sensitive for PAHs of higher molecular weight. HRSS was useful the quantifying heavy PAHs and was more rapid, could be automated, and gave accurate results. However, in an oil-pollution study, it must be backed-up by other techniques. (Author's abstract)
W91-12474

APPLICATION OF THE HIGH-RESOLUTION LOW TEMPERATURE SPECTROFLUOROMETRY TO ANALYSIS OF PAHS IN LAKE SEDIMENTS, MARINE INTERTIDAL SEDIMENTS AND ORGANISMS.
Universite de Savoie, Chambery (France). Lab. de Chimie et Ingenierie de l'Environnement.
A. Saber, G. Morel, L. Paturel, J. Jarosz, and M. Martin-Bouyer.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 339, No. 10, p 716-721, April 1991. 8 fig, 22 ref.

Descriptors: *Chemical analysis, *Hydrocarbons, *Lake sediments, *Marine sediments, *Pollutant identification, *Polycyclic aromatic hydrocarbons, *Spectrofluorometry, *Tissue analysis, Aromatic compounds, Automobile emissions, France, Gulf of Kuwait, Intertidal areas, Mollusks.

Polycyclic aromatic hydrocarbons (PAHs) are largely anthropogenic, coming from such sources as redeposited airborne particles, industrial and domestic wastewater, runoff from roads, and oil spills. High-resolution low-temperature spectrofluorometry (Shpol'skii effect) was applied to the quantitative analysis of PAHs in lake sediments, marine intertidal sediments, and marine organisms. Various studies demonstrated the use of this technique, including: a correlation assay between the PAH distribution in sediments of Alpine lake and that determined in vehicle exhaust emissions weighted from the accurate representation of the total number of passenger cars in France and an investigation of concentration profiles and PAH distribution in intertidal and bivalves from the Gulf of Kuwait. In an analysis of 13 PAHs in the laboratory, the relative errors, determined by using weighted linear regression, varied from 10% for the high concentration levels to 50% near the detection limits. (Rochester-PTT)
W91-12475

SHPOL'SKII FLUORIMETRIC DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN COMPLEX ENVIRONMENTAL SAMPLES.
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
F. Ariese, C. Gooijer, N. H. Velthorst, and J. W. Hofstraat.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 339, No. 10, p 722-724, April 1991. 6 fig, 9 ref.

Descriptors: *Chemical analysis, *Fluorometry, *Hydrocarbons, *Pollutant identification, *Polycyclic aromatic hydrocarbons, *Spectroscopy, Aromatic compounds, Laser Excited Shpolskii Spectroscopy, Performance evaluation, Shpolskii effect.

Cooling aromatic compounds results in a remarkable gain in spectral resolution (line width about 0.1 nanometer) while sensitivity is increased by two orders of magnitude (Shpol'skii effect). High-resolution fluorimetry in low-temperature n-alkane Shpol'skii matrices is a powerful technique for the analysis of rigid, non-polar compounds like polycyclic aromatic hydrocarbons. Because of the method's sensitivity and selectivity, sample cleanup, preconcentration, and even chromatographic separation can be omitted. The Shpol'skii analysis of pyrene extracts in crude extracts from marine sediments and from bird meat was done to demonstrate the method. Additional possibilities are acquired when a laser is used as an excitation source (Laser Excited Shpol'skii Spectroscopy, LESS). The use of laser excitation with tern samples demonstrated that both sensitivity and selectivity were remarkably improved. For trace-level analysis of polycyclic aromatic hydrocarbons in complex samples it will be essential to employ laser excitation. (Rochester-PTT)
W91-12476

ASSESSMENT OF EXTRACTION METHODOLOGIES FOR MEASURING SUBSURFACE CONTAMINATION.
Gradient Corp., Cambridge, MA.
A. C. Roche, and C. T. Miller.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 339, No. 10, p 732-739, April 1991. 4 fig, 4 tab, 25 ref.

Descriptors: *Chemical analysis, *Extraction procedures, *Groundwater pollution, *Laboratory methods, *Organic compounds, *Pollutant identification, Nitrogen purge, Performance evaluation, Ultrasonication pentane extraction, Ultrasound, Volatility.

Remediation of contaminated groundwaters can be assisted by accurate measurements of contaminant distributions. Two analytical methods for the extraction of volatile organics from subsurface solids were examined in laboratory recovery experiments. An ultrasonication pentane extraction procedure analyzing subsamples from a brass core containing approximately 600 g of contaminated solids yielded 83-100% recovery for the compounds tested. For the second method, a nitrogen purge was applied for 20 hr to a heated brass core containing subsurface material, effectively desorbing and trapping the volatile organics onto activated carbon. Recoveries from this method ranged from 80-100% of the contaminant mass present. Both methods were applied at a gasoline-contami-

nated field site. It was expected that the larger solid sample from the nitrogen purge sample would lead to more reproducible field results than the ultrasonication method. However, this result was not found; the ultrasonication field results were more accurate, with < 10% standard deviation for field replicate measurements. (Author's abstract)
W91-12477

DUAL-COLUMN HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC CLEANUP PROCEDURE FOR THE DETERMINATION OF POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS IN FISH TISSUE.
Ontario Ministry of the Environment, Rexdale. Lab. Services Branch.
T. S. Thompson, T. M. Kolic, and K. A. MacPherson.
Journal of Chromatography JOCRAM, Vol. 543, No. 1, p 49-58, April 26, 1991. 4 fig, 4 tab, 18 ref.

Descriptors: *Dibenzofurans, *Dioxins, *High performance liquid chromatography, *Pollutant identification, *Sample preparation, *Tissue analysis, Chlorinated hydrocarbons, Fish, Gas chromatography, Laboratory methods, Mass spectroscopy.

The presence of polychlorinated diphenyl ethers (PCDPEs) poses a major problem in the determination of polychlorinated dibenzofurans (PCDFs) by gas chromatography (GC)-mass spectroscopy (MS) because these compounds rearrange under electron impact ionization conditions to yield ions corresponding to PCDF molecular ions. A high-performance liquid chromatographic cleanup procedure employing normal-phase alumina and carbon-silica separations was developed for isolating polychlorinated dibenzo-p-dioxins (PCDDs) and PCDFs from other polychlorinated pollutants present in fish tissue. The method utilizes a column-switching step where dioxins and furans are trace enriched onto a carbon-silica column as they are eluted from the alumina column. Interfering components such as polychlorinated biphenyls and chlorinated diphenyl ethers elute through the carbon-silica column. The PCDDs and PCDFs are recovered subsequently by backflushing the carbon-silica column using toluene. (Author's abstract)
W91-12481

IDENTIFICATION OF BACTERIOCHLOROPHYLLS IN LAKES VIA REVERSE-PHASE HPLC.
Wisconsin Univ.-Madison. Center for Limnology.
For primary bibliographic entry see Field 2H.
W91-12485

SEMIAUTOMATIC, WET-OXIDATION METHOD FOR THE DETERMINATION OF PARTICULATE ORGANIC NITROGEN COLLECTED ON FILTERS.
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 2K.
W91-12492

LOSS ON IGNITION AND KJELDAHL DIGESTION FOR ESTIMATING ORGANIC CARBON AND TOTAL NITROGEN IN ESTUARINE MARSH SOILS: CALIBRATION WITH DRY COMBUSTION.
Duke Univ., Durham, NC. Duke Environmental Center.
For primary bibliographic entry see Field 7B.
W91-12501

MONITORING GROUNDWATER AND WELL WATER FOR CROP PROTECTION CHEMICALS.
Monsanto Co., St. Louis, MO.
J. A. Graham.
Analytical Chemistry ANCHAM, Vol. 63, No. 11, p 613-614, 616,618-620, June 1991. 2 fig, 39 ref.

Descriptors: *Agricultural chemicals, *Experimental design, *Groundwater pollution, *Monitoring, *Network design, *Nonpoint pollution sources, *Pollutant identification, *Water quality monitoring, Analytical methods, Laboratory methods, Sampling, Subsurface water, Well water.

A summary is given of the areas requiring the most immediate attention for the monitoring of groundwater and well water for crop protection chemicals. It has been proposed that any study design should contain three parts: a basis for separating the contamination of interest from the background, an independent method for assessing errors in sampling and measurement, and a protocol for making trace chemical measurements and reporting results. Studies that assess the occurrence of crop protection chemicals (CPCs) in groundwater and well water can generally be categorized as either prospective or retrospective. The primary objective of a prospective study is characterization of the subsurface environmental fate of a particular CPC or combination of CPCs. The objective of a retrospective study is assessment of the extent of occurrence of a particular CPC or combination of CPCs in well water or groundwater in a specifically defined population or location. Once a general study design has been identified, one or more protocols must be developed to conduct the various phases. With respect to chemical measurements, a water sampling and chemical analysis protocol must be developed. Although sampling and analysis can be incorporated into a single protocol, it is generally more straightforward to develop protocols for each separately. The final step is the objective evaluation and interpretation of the data. A classic example of the pitfalls of data interpretation is given by reviewing the Clayton County Big Spring Basin, Iowa, studies. The example illustrates the dangers of overinterpreting limited results and demonstrates the need for a multidisciplinary approach to the problem. (Agostine-PTT)
W91-12536

SIMULTANEOUS DETERMINATION OF INORGANIC ARSENIC AND ANTIMONY SPECIES IN NATURAL WATERS USING SELECTIVE HYDRIDE GENERATION WITH GAS CHROMATOGRAPHY/PHOTOIONIZATION DETECTION.
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
L. S. Cutter, G. A. Cutter, and M. L. C. San Diego-McGlone.
Analytical Chemistry ANCHAM, Vol. 63, No. 11, p 1138-1142, June 1991. 3 fig, 3 tab, 18 ref. NSF Grants ATM-8701710 and OCE-8608823.

Descriptors: *Analytical methods, *Antimony, *Arsenic, *Chemical analysis, *Gas chromatography, *Heavy metals, *Pollutant identification, *Water analysis, Detection limits, Field tests, Sediment analysis.

Dissolved arsenic and antimony in natural waters can exist in the trivalent and pentavalent oxidation states, and the biochemical and geochemical reactivities of these elements are dependent upon their chemical forms. A method for the simultaneous determination of As(III) + Sb(III) and As(III + V) + Sb(III + V) has been developed that uses selective hydride generation, liquid nitrogen cooled trapping, and gas chromatography/photoionization detection. The detection limit for arsenic is 10 pmol/L, while that for antimony is 3.3 pmol/L; precision (as relative standard deviation) for both elements is better than 3%. The apparatus is rugged and allows determinations to be made in the field. In addition to determining dissolved arsenic and antimony species, an oxidative digest has been developed to allow the simultaneous determination of the two elements in sediments and biogenic particles. Numerous water and particulate samples have been analyzed by using the described procedures. These results show that the methods can be used for many different sample types and widely varying concentrations. (Author's abstract)
W91-12537

LIQUID CHROMATOGRAPHIC DETERMINATION OF LINEAR ALKYLBENZENESULFONATES IN AQUEOUS ENVIRONMENTAL SAMPLES.
Rome Univ. (Italy). Dept. of Chemistry.
A. Di Corcia, M. Marchetti, R. Samperi, and A. Marcomini.
Analytical Chemistry ANCHAM, Vol. 63, No. 11, p 1179-1182, June 1991. 3 fig, 3 tab, 25 ref.

Descriptors: *Alkylbenzene sulfonates, *Analytical methods, *Chemical analysis, *Liquid chromatography, *Organic compounds, *Pollutant identification, *Water analysis, Detection limits, Detergents, Field tests, Laboratory methods.

A selective, rapid, simple, and inexpensive method was developed for the HPLC analysis of linear alkylbenzenesulfonates (LAS) in actual water samples from various sources. LAS were extracted by a Carbopack cartridge from water samples without any sample pretreatment. Before desorbing LAS, a suitable washing step succeeded in removing from the sorbent surface basic, neutral, and weakly acidic compounds, which may interfere with the subsequent quantification of LAS. The precision of the method was determined by repeated analyses (n=6) of each type of aqueous environmental sample considered. The relative standard deviations obtained were 4.7% for samples of an influent sewage, 3.6% for effluent sewage, and 3.0% for river water. The detection level was approximately 0.004 microgram for each LAS homologue. Thus, the detection limit of this method was 0.8 ppb for the total LAS for river water specimens, under the experimental conditions chosen. The sample preparation method was compared with two recently reported extraction procedures. Data obtained by the present procedure were in good agreement with a procedure making use of a trap tandem system. The procedure developed here appears far simpler, more rapid, and less expensive. In addition, this extraction procedure is more adaptable to field sampling, as it requires no pretreatment. (Agostine-PTT)
W91-12538

SEASONAL VARIATIONS IN THE CONCENTRATION OF BE-10, CL(-), NO3(-), SO4(2-), H2O2, PB-210, H-3, MINERAL DUST, AND DELTA O-18 IN GREENLAND SNOW.
Bern Univ. (Switzerland). Physikalisches Inst.
J. Beer, R. C. Finkel, G. Bonani, H. Gaggeler, and U. Gorlach.
Atmospheric Environment ATENBP, Vol. 25A, No. 5/6, p 899-904, 1991. 2 fig, 1 tab, 26 ref.

Descriptors: *Acid rain, *Greenland, *Isotopes, *Path of pollutants, *Pollutant identification, *Seasonal variation, *Snow, *Tracers, Analytical methods, Beryllium, Hydrogen peroxide, Lead, Manganese, Nitrates, Oxygen, Sulfates.

A detailed snow pit study at Dye 3, South Greenland, has been carried out in order to investigate the seasonal variations of Be-10, Cl(-), NO3(-), SO4(2-), H2O2, Pb-210, H-3, Mn and delta O-18. Special emphasis was placed on understanding the causes of Be-10 variations because this isotope can be used to trace the history of solar activity. A sampling interval of 5 cm was chosen to assure a mean time resolution of about 20 samples per year for the period 1978-1983. Four different categories of seasonal variations were identified: strong summer peaks (delta O-18, H2O2, H-3), weak bimodal peaks (NO3(-), SO4(2-), conductivity, Be-10), a fall peak (Pb-210) and a winter-spring peak (Cl(-), Mn). Although this is far from a detailed understanding of the mechanisms which control the measured compositions, there are indications that different processes dominate at different seasons. NO3(-), SO4(2-), Mn, and Cl(-) variation suggest that aerosol transport is most important during winter-spring. In summer-fall there seems to exist a second period of long range transport from low latitude continental areas resulting in enhanced concentrations of Pb-210, Be-10, and SO4(2-). (Author's abstract)
W91-12541

SPATIAL AND TEMPORAL VARIABILITY OF RIME ICE AND SNOW CHEMISTRY AT FIVE SITES IN CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.

N. Berg, P. Dunn, and M. Fenn.
Atmospheric Environment ATENBP, Vol. 25A, No. 5/6, p 915-926, 1991. 5 fig, 3 tab, 24 ref.

Descriptors: *Acid rain, *California, *Chemistry of precipitation, *Ice, *Rime, *Snow, *Water pollution sources, Air pollution effects, Calcium, Chlorides, Hydrogen ion concentration, Ions, Magnesium, Nitrates, Pollutant identification, Potassium, Sodium, Sulfates, Temporal variation, Variability.

Snow collected on the ground and rime ice collected on surrogate surfaces at five sites in California were analyzed for major ion concentrations during winters 1986-1987 and 1987-1988. Temporal variation in rime chemistry was large, with maximum values 5-40 times the magnitude of minimum values during the winter 1987-1988. Mean concentration differences among rime events at individual locations were often as large as mean differences among sites. On the local scale, no significant differences in rime and snow mean concentrations of H(+), NO3(-), SO4(2-), Cl(-), Na(+), K(+), Mg(2+) and Ca(2+) were identified at three nearby sites in the central Sierra Nevada. Among sites in central and northern California, and immediately downwind of the Los Angeles basin, mean SO4(2-), Cl(-) and Ca(2+) solute concentrations in rime were significantly greater at the southern California location during the winter of 1987-1988. The mean concentration of NO3(-) in rime at the southern California site was 2-8 times as high as in the central and northern California sites, but was not significantly different because of variation between rime events at all sites. Between the winters of 1986-1987 and 1987-1988 mean concentrations of K(+), Mg(2+), and Ca(2+) in rime and snow samples from most sites differed significantly, largely because winter 1987-1988 concentrations of these constituents were low or undetectable in many samples. During both winters mean concentrations of H(+), NO3(-), SO4(2-), Cl(-), Na(+), K(+), Mg(2+) and Ca(2+) were higher in rime samples than in snow samples collected concurrently. (Author's abstract)
W91-12542

CORRELATION OF FLURIDONE AND DYE CONCENTRATIONS IN WATER FOLLOWING CONCURRENT APPLICATION.
Florida Univ., Gainesville. Dept. of Agronomy.
A. M. Fox, W. T. Haller, and D. G. Shilling.
Pesticide Science PSSCBG, Vol. 31, No. 1, p 25-36, 1991. 6 fig, 2 tab, 17 ref. U.S. Dept. of Agriculture Cooperative Research Program ARS 58-434K-0001.

Descriptors: *Dyes, *Fluridone, *Herbicides, *Monitoring, *Path of pollutants, *Pesticide residues, *Tracers, Analytical methods, Correlation analysis, Economic aspects, High performance liquid chromatography, Lakes.

Herbicide residue samples are expensive and time-consuming to collect and analyze. To test whether Rhodamine WT dye could simulate the dissipation of fluridone, concurrent applications of the chemicals were made in the weed-infested Three Sisters tidal canals (Citrus Co, FL) and a shallow lake in the Upper St Johns River, Florida. Dye concentrations were measured using a field fluorometer and fluridone concentrations were analyzed by an HPLC method. The coefficient of correlation between dye and herbicide was 0.99 in the canals and 0.93 in Lake Hell'n'Blazes (Upper St Johns River) over 340 and 93 h respectively. Half-lives of the chemicals were not significantly different for either site. The significant correlations of dye and fluridone concentrations at these two contrasting sites indicated a linear relationship between the chemicals over a range of concentrations. The gradients of the dye versus fluridone regressions will be specific to each application. Thus, a few fluridone residues would have to be analyzed to establish a regression equation specific to a particular application. This equation could be used to calculate fluridone concentrations for a large number of dye readings taken in the field, saving the expenditure of time and money involved in the analysis of large numbers of herbicide residues. Such data would be of particular value in studies of fluridone residue distribution, such as those required for herbicide registration. (Agostine-PTT)
W91-12554

SEPARATION OF PESTICIDES, RELATED COMPOUNDS, POLYCHLOROBIPHENYLS AND OTHER POLLUTANTS INTO FOUR GROUPS BY SILICA-GEL MICROCOLUMN CHROMATOGRAPHY (APPLICATION TO SURFACE WATER ANALYSIS).
Aquila Univ. (Italy). Ist. d'Igiene.
V. Leoni, C. Cremisini, A. Casuccio, and A. Gullotti.
Pesticide Science PSSCBG, Vol. 31, No. 2, p 209-220, 1991. 2 fig, 3 tab, 44 ref.

Descriptors: *Chromatography, *Error analysis, *Pesticide residues, *Pesticides, *Pollutant identification, *Polychlorinated biphenyls, *Separation techniques, *Silica, *Water analysis, Analytical methods, Drinking water, Laboratory methods, Water, Water quality monitoring.

Multi-residue analyses of pesticides and related compounds generally require clean-up procedures for the elimination of interfering substances. An analytical procedure for use in the recovery and determination of pesticides and other pollutants in water samples is described, in which the purification of the extracts is improved by the separation of pesticides into four groups. This was accomplished using four eluents: (1) n-hexane; (2) benzene + n-hexane (60 + 40 by volume); (3) benzene; and (4) ethyl acetate + benzene (50 + 50 by volume). The total analytical error of plus or minus 20% may be considered barely satisfactory from the strictly legal point of view of control by many regulators. On the other hand, the EC (European Community) Directive 79/869 (concerning the analytical methods and the sampling frequency for surface waters to be used for the production of drinking water) considers plus or minus 50% to be an adequate value for both precision and accuracy for pesticide analyses at the detection limit level. On the basis of these considerations, the analytical method proposed should be considered largely acceptable for pesticide residue analyses. (Agostine-PTT)
W91-12555

OPTIMUM ALLOCATION OF MONITORING WELLS AROUND A SOLID-WASTE LANDFILL SITE USING PRECURSOR INDICATORS AND FUZZY UTILITY FUNCTIONS.
Kyoto Univ. (Japan). Dept. of Environmental and Sanitary Engineering.
S. Morisawa, and Y. Inoue.
Journal of Contaminant Hydrology JCOHE6, Vol. 7, No. 4, p 337-370, June 1991. 13 fig, 13 tab, 17 ref, 1 append.

Descriptors: *Computer models, *Fuzzy mathematics, *Landfills, *Model studies, *Monitoring wells, *Network design, *Path of pollutants, *Solid wastes, Adsorption, Convection, Desorption, Dispersion, Finite difference methods, Monte Carlo method, Uncertainty, Unconsolidated aquifers.

An optimum monitoring well network which enables rapid, redundant and economical detection of contaminants in groundwater around a solid-waste landfill site is purposed. The procedure also guarantees detection of the contaminants given data on the probability of detection at different points in the saturated zone. The well selection is accomplished using a two-step procedure. In the first step, a Monte Carlo simulation of contaminant transport in the unconsolidated shallow saturated zone is conducted where hydrogeological parameters are variable but their stochastic distributions are known. Three governing equations are solved numerically using the finite-difference method to obtain the travel time distribution of each contaminant: the two-dimensional steady-state groundwater flow equations; the two-dimensional transient convective-dispersion equation for sorptive contaminants; and the sorptive-desorptive isotherm equation. In the second step, the procedure utilizes 'fuzzy' theory, comprised of a set of newly developed mathematical techniques to deal with uncertainty in a wide range of man-machine interface issues, to assist in the design of a monitoring well network. The procedure requires a mathematical description of a four-attribute design problem using utility functions and fuzzy weights. An optimum monitoring well network is then defined as the network having maximum total unity, which is evaluated as a fuzzy expectation of weighted arithmetic sums of the four utilities. The simulation defines relationships between the contaminant of interest and precursor materials. The precursor material can then serve as an 'indicator' for faster detection of contaminant leaked from a solid-waste landfill site. The procedures are applied to a hypothetical solid-waste landfill site to obtain the optimum monitoring well network for detection of precursor indicators. Sensitivity analysis of the optimum network was conducted by considering changes in components including the total utility evaluation, quality of uncertainty in weight factor and utility evaluation, weight level determination, delay time requirement, well number limitation and perfect detection constraint. (Author's abstract)
W91-12557

MITOCHONDRIAL BIOASSAY FOR TOXIC SUBSTANCES IN WATER.
Wisconsin Univ., Madison. Water Resources Center.
J. M. Harkin, G. A. Blondin, L. M. Knobeloch, and H. W. Read.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-192419. Price codes: A08 in paper copy, A01 in microfiche. Final Technical Report, April 1991. 152p, 58 fig, 54 tab, 64 ref. USGS Contract No. 14-08-0001-G1295.

Descriptors: *Bioassay, *Environmental monitoring, *Mitochondria, *Pollutant identification, *Testing procedures, *Toxicity, Adenosine triphosphate, Advanced wastewater treatment, Aquatic life, Bioindicators, Biological membranes, Carcinogens, Fish, Green Bay Metropolitan Sewage District, Illinois River Basin, Minnesota River Basin, Pesticide toxicity, Trace metals, Water quality.

Budgetary constraints and the demand for improved turnaround time have created a critical need for rapid and inexpensive bioassay systems as alternatives to fish and aquatic invertebrate tests for monitoring toxicity in surface water and groundwater, effluents, and leachates. In new bioassays, phosphorylating submitochondrial particles (SMP), prepared by sonic disruption of intact bovine heart mitochondria, serve as surrogate in vitro biomonitors of aquatic toxicity. Three 5-, to 20-minute SMP test procedures were designed which provide maximum overall sensitivity to a broad array of 113 toxic chemicals and heavy metals tested. Statistical analysis applied to a linear regression of in vitro SMP EC-50 values versus in vivo LC-50 toxicity responses in 96-hr fish tests yielded an excellent correlation (R-squared = 90%); SMP is a good predictor of toxicity responses in fish. SMP test procedures were validated by field trials through participation in several ongoing U.S. EPA, U.S.G.S., or Wisconsin-DNR biomonitoring projects, including studies in the Illinois and Minnesota River basins. The results of these studies illustrate the utility of the SMP test system as a reliable, rapid, and inexpensive prescreening tool in a wide range of water quality assessment projects. (USGS)
W91-12635

AQUACULTURE/MARINE FISHERIES PROCESS WASTEWATERS.
Louisiana State Univ., Baton Rouge. Cooperative Extension Service.
B. Branch.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-192377. Price codes: A03 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute, Baton Rouge, Project Completion Report, September 1990. 18p, 4 tab, 14 ref, 4 append. USGS Project No. G1565-03.

Descriptors: *Louisiana, *Pollutant identification, *Wastewater analysis, Aquaculture, Fisheries, Industrial wastewater, Wastewater treatment, Water quality standards.

Wastewater samples from alligator production/processing facilities, and from crawfish, catfish and crab processing plants were collected and analyzed to determine quality and quantity characteristics which would help producers/processors prepare permit applications and/or reduce costs of managing wastewater and help the Louisiana Department of Environmental Quality establish wastewater discharge permits, and consultants design treatment systems. Little data was previously available to characterize alligator or crawfish wastewater and for small plants processing other species. Results from alligator wastewater analysis indicated considerable variation between facilities and within facilities depending on time of sample collection. Crawfish processing wastewater varies with the process being sampled and time of day. Boiling process generates strongest effluent. Catfish and crab samples varied somewhat from published data. Technology transfer programs with Fisheries Agents, regulatory agency staff and producers/processors have been instrumental in increasing understanding of problems and probable solutions. (Bankston-LA State U)
W91-12639

SURFACE WATER ACIDIFICATION: A COMPARISON OF METHODS FOR PH DETERMINATION IN WEAKLY BUFFERED NATURAL WATERS.
Freiburg Univ. (Germany, F.R.). Inst. fuer Physische Geographie.
For primary bibliographic entry see Field 7B.
W91-12775

IMPROVEMENT IN ACCURACY OF THE INTERPRETATION OF ALGAL GROWTH CURVES USING A 200 CHANNEL AUTOMATIC BATCH CULTURE APPARATUS.
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W91-12779

SAPROPHYTIC AND FAECAL COLIFORM BACTERIA IN THE SEDIMENT OF THE IMPOUNDMENT ALTENWORTH.
O. Albinger.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1324-1329, March 1991. 6 fig, 8 tab, 13 ref.

Descriptors: *Bacterial analysis, *Bioindicators, *Danube River, *Fecal coliforms, *Microbiological studies, *Reservoirs, *Sampling, *Sediment analysis, *Water quality monitoring, Fate of pollutants, Path of pollutants, Sediment contamination, Sediment sampling, Separation techniques, Standardization, Vertical profile, Wastewater pollution.

The occurrence of saprophytic and fecal coliform bacteria at different depths in the sediment of the Altenworth impoundment of the Danube River, sampled with a multicorer, was tested to obtain fundamentals of bacteriological sediment data to describe the hygienic status of water quality. In 1987/1988, the numbers of saprophytic and fecal coliform bacteria were investigated in 54 vertical profiles (6 per month) at stream-km 1984, 20 m from the right bank, near the outflow of a wastewater Canal (the wastewater was only mechanically purified). Samples were homogenized and analyzed using the membrane filtration technique. The numbers of both types of bacteria decreased significantly within the first centimeters of the sediment profile. Therefore, these results indicate a need to standardize the sampling depth for sediment investigations when results are applied to water quality systems. It is suggested that the sampling depth for fecal coliform bacteria in sediment be standardized at 0-1 cm. (Brunone-PTT)
W91-12789

CHEMICAL REACTIONS OF METALS WITH HUMIC MATERIAL.
Institute of Terrestrial Ecology, Grange-over-Sands (England). Merlewood Research Station.
For primary bibliographic entry see Field 2K.
W91-12808

ESTIMATING OIL AND GREASE CONTENT OF PETROLEUM-CONTAMINATED SOIL.
Cornell Univ., Ithaca, NY. Center for Environmental Research.
J. H. Martin, A. J. Siebert, and R. C. Loehr.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 117, No. 3, p 291-299, May/June 1991. 2 fig, 8 tab, 11 ref. EPA Cooperative Agreement CR-809285.

Descriptors: *Grease, *Laboratory methods, *Oil pollution, *Pollutant identification, Chemical analysis, Freon, Methylene chloride.

The precision and accuracy of estimating the oil and grease content of petroleum-contaminated soil using acidification, followed by Soxhlet extraction with trichlorotrifluoroethane (freon) and methylene chloride, are compared. Stock oil-soil mixtures prepared with vegetable oil, no. 2 and no. 6 fuel oil, SAE 30 nondetergent motor oil, and an oily petroleum waste were analyzed. The analytical results obtained using freon were the most precise; using freon, the coefficient of variation for all oil-soil mixtures analyzed never exceeds 4%, compared to 9% when methylene chloride was used as the solvent. Percent recovery varies with oil type, with freon providing more accurate estimates of vegetable oil and no. 2 fuel-oil concentrations, and methylene chloride giving a more accurate estimate of no. 6 fuel-oil concentration. Recoveries slightly exceeded 100% for both motor oils using freon and the oil petroleum waste using methylene chloride. These results suggest that either freon or methylene chloride can be used to provide reasonably precise and accurate estimates of the oil and grease content of contaminated soils. (Author's abstract)
W91-12818

SIGNIFICANCE OF SEVERAL BACTERIOPHAGE GROUPS AS INDICATORS OF SEWAGE POLLUTION IN MARINE WATERS.
Malaga Univ. (Spain). Dept. of Microbiology.
R. Cornax, M. A. Morinigo, M. C. Balebona, D. Castro, and J. J. Borrego.
Water Research WATRAG, Vol. 25, No. 6, p 673-678, June 1991. 1 fig, 2 tab, 41 ref. United Nations Environmental Programme/World Health Organization grant SPA-026-K.

Descriptors: *Bacteriophage, *Bioindicators, *Marine pollution, *Pollutant identification, *Wastewater pollution, Analytical methods, Coliforms, Fecal bacteria, Fecal coliforms, Fecal streptococci.

Seawater samples collected from two beaches with different levels of pollution were studied for the presence of classically and newly proposed fecal indicators such as total and fecal coliforms, fecal streptococci, coliphages, F-specific phages and bacteriophages of Bacteroides fragilis. Total and fecal coliforms showed lower survival rates in seawater than fecal streptococci, F-specific bacteriophages and coliphages. On the other hand, total coliform concentrations were only higher than those of fecal coliforms in heavily polluted seawater, although in samples with a low level of pollution, fecal streptococci and Escherichia coli C phage counts were generally greater than those showed by fecal coliforms. The low concentration in which F-specific and B. fragilis bacteriophages were detected in marine waters compared to the E. coli bacteriophage levels, is an important shortcoming for the general use of the former microorganisms as universal indicators of fecal pollution. From the results obtained, it may be concluded that fecal streptococci and E. coli C bacteriophages are the most appropriate indicators of the remote pollution in marine waters. (Author's abstract)
W91-12852

DERIVING QUALITY CRITERIA FOR WATER AND SEDIMENT FROM THE RESULTS OF AQUATIC TOXICITY TESTS AND PRODUCT STANDARDS: APPLICATION OF THE EQUILIBRIUM PARTITIONING METHOD.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
For primary bibliographic entry see Field 5G.
W91-12855

EFFECTS OF SAMPLING TECHNIQUES ON THE GAMMARUS:ASELLUS RATIO.
Brighton Polytechnic (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W91-12860

CONTINUOUS DETERMINATION OF TOTAL SOLUBLE NITROGEN IN WASTE WATER USING ON-LINE PHOTOOXIDATION AND FLOW INJECTION ANALYSIS (ONLINE-VERFAHREN ZUR BESTIMMUNG VON LOSLICHEM GESAMT-STICKSTOFF IN ABWASSERN DURCH KOPPLUNG EINES UV-AUFSCHLUSSES MIT DER FLIESSINJEKTIONSANALYSE).
Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Anorganische und Analytische Chemie.
S. Hinkamp, and G. Schwedt.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 24, No. 2, p 60-65 April 1991. 3 fig, 2 tab, 21 ref. English summary.

Descriptors: *Analytical methods, *Nitrogen, *Oxidation, *Photochemistry, *Wastewater analysis, *Water analysis, *Water quality, Digestion, Nitrogen compounds, Wastewater treatment.

An on-line method was developed to determine total soluble nitrogen content (TN) in wastewaters, based on the coupling of UV-digestion with flow injection analysis. In this process, both inorganic and organic N-compounds are photooxidized to nitrate in an alkaline solution of potassium peroxodisulfate; nitrate is detected at 226 nm. Recoveries of nitrogen vary from 85-100%. The applicability of the method to wastewater samples is shown and compared to manual digestion methods. (Author's abstract)
W91-12862

INTERLABORATORY TEST FOR THE DETERMINATION OF S-TRIAZINES IN WATER SAMPLES (ZWEITE VERGLEICHSUNTERSUCHUNG ZUR BESTIMMUNG VON S-TRIAZINEN IN WASSERPROBEN).
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 24, No. 2, p 65-70, April 1991. 3 fig, 2 tab, 3 ref. English summary.

Descriptors: *Analytical methods, *Immunoassay, *Interlaboratory comparison, *Pesticides, *Pollutant identification, *Rhine River, *Triazines, *Water analysis, Atrazine, Chemical analysis, Drinking water, Enzymes, Gas chromatography, Germany, Mass spectrometry, Water quality.

Interlaboratory tests on the applicability of enzyme immunoassays for the detection of herbicides in water analysis, were conducted. Six samples of drinking water and surface water from the Rhine River were analyzed both in the natural state and after supplementation with atrazine and deethylatrazine; two of the spiked surface water samples were identical. Three laboratories carried out GC of GC/MS analyses for comparison. All immunoassays correctly recognized the zero sample (drinking water) and generally yielded the same results for the identical samples 3 and 4 (water from the Rhine River, supplemented with atrazine). One immunoassay yielded fairly accurate results for the atrazine concentrations, while the other two tests were more suitable for group determination of s-triazines. This was explained by different cross-reactivities of the applied antibodies. A second interlaboratory test proved the principle qualification of immunoassays for the detection of environmental chemicals. Under the proper condi-

tions, immunoassays can be considered to be rapid and relatively simple screening procedures which provide a valuable contribution to the analysis of pesticides. (Author's abstract)
W91-12863

DIAZIDO(4,4')-DISULFO(2,2')-STILBEN-IMPREGNATED SORPTION LAYERS IN THE THIN LAYER CHROMATOGRAPHY FOR THE ANALYSIS OF PHENOLIC COMPOUNDS IN WATER (DIAZIDO(4,4')-DISULFO(2,2')-STILBENIMPRAGNIERTE SORPTIONSSCHICHTEN FUR DIE DUNNSCHICHTCHROMATOGRAPHIE ZUR PHENOLANALYTIK VON WASSERN).
Med.-Techn. Bereiches Kreiskrankenhaus Treuenbrietzen, 1701-Treuenbrietzen, Juterboger Str. 68, Germany.
V. H. Thielemann.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 24, No. 2, p 94-95, April 1991. 1 tab, 1 ref. (English summary).

Descriptors: *Chemical analysis, *Phenols, *Pollutant identification, *Thin layer chromatography, *Water analysis, Chromatography, Laboratory methods, Organic compounds.

The use of diazido(4,4')-disulfo(2,2')-stilben impregnated sorptive layers, in thin layer chromatography is discussed, specifically, for the analysis of phenolic compounds in water. It was found that the prepared sorptive layers provide rapid and precise results. (Author's abstract)
W91-12867

MICROBIAL CONTAMINATION AS AN INDICATOR OF SEWER LEAKAGE.
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5B.
W91-12908

ELECTROCHEMICAL ASSESSMENT OF ESCHERICHIA COLI SURVIVAL IN NATURAL WATER.
Rouen Univ., Mont-Saint-Aignan (France). Lab. de Chimie Macromoleculaire.
T. Jouenne, L. Bertin, G. Charriere, and G. A. Junter.
Water Research WATRAG, Vol. 25, No. 7, p 829-833, July 1991. 4 fig, 17 ref.

Descriptors: *Bioindicators, *Ecosystems, *Electrochemistry, *Escherichia coli, *Natural waters, *Pollutant identification, Bacterial growth, Biomass, Coliforms, Growth rates, Microbiological studies, Stress, Sublethal effects, Water quality.

The survival patterns of two wild strains of Escherichia coli (clinical isolates from human feces) were compared during in situ exposure of the organisms to environmental freshwater in dialysis tubing sacs. The sublethal stress was evaluated by both standard enumeration techniques on sedative or non-selective solid media, and an electrochemical detection procedure based on the potentiometric measurement of lipoic acid reduction. Apparent growth rates were calculated from the potentiometric data, providing accurate information on the ability of injured bacteria to multiply. Significant differences between the survival patterns of the two bacterial strains were highlighted by both the electrochemical and the conventional techniques. The recovery of both strains on coliform-selective, lactose-deoxycholate agar was much less efficient than on non-selective solid medium. From the standard plate counts on non-selective agar, the time required for the cell population to decrease by 90% of its original value varied from 7 to 20 days, according to the strain tested. Using coliform-selective plate counts, this time was from 7-20 days, according to the strain tested. Using coliform-selective plate counts, this time was reduced to 3 or 10 days. Loss in viability was correlated with an increase in the potentiometric generation time, which increased from 19 to 33 min in 22 days for one strain, from 20 to 48 min. in 8 days for the other strain. This study shows that the potentiometric technique may be suitable to evaluate the sublethal stress of microorganisms released in natural environments. (Author's abstract)
W91-12913

BRAIN ACETYLCHOLINESTERASE AS AN IN VITRO DETECTOR OF ORGANOPHOSPHORUS AND CARBAMATE INSECTICIDES IN WATER.
Universidade do Estado do Rio de Janeiro (Brazil). Inst. de Biologia.
V. L. F. Cunha Bastos, J. Cunha Basatos, J. S. Lima, and M. V. Castro Faria.
Water Research WATRAG, Vol. 25, No. 7, p 835-840, July 1991. 4 fig, 4 tab, 16 ref.

Descriptors: *Acetylcholinesterase, *Bioindicators, *Carbamate pesticides, *Organophosphorus pesticides, *Paraibo do Sul River, *Pesticides, *Pollutant identification, Bioassay, Brazil, Chemical analysis, Diazinon, Enzymes, Insecticides, Laboratory methods, Malathion, Parathion, Tissue analysis.

An inexpensive but accurate enzymatic method is proposed for the detection of carbamate and organophosphorus pesticides contaminating water supplies. The method uses an acetylcholinesterase preparation obtained after extraction of rat brain microsomal fraction with Triton X-100, and is based on inhibition of acetylcholinesterase in the presence of the pesticides. Some phosphorothionate insecticides (e.g. parathion, malathion), which are not direct acetylcholinesterase inhibitors, can also be activated by preincubation with the enzyme preparation. Enzyme assay is performed by a potentiometric method based on the formation of acetic acid in the incubation mixture. Interference of any eventual buffering capacity of the sample can be easily corrected. Malathion, parathion, diazinon and deoxicarbamate inhibited the enzyme at least 20% when they were added to the medium in the limit concentration recommended for public water supplies (0.1 mg/L). The method was evaluated in samples collected from selected locations of the Paraibo do Sul river, Rio de Janeiro, Brazil, and it proved to be sufficiently practical and accurate as an alarm routine test for such pesticide classes. (Author's abstract)
W91-12914

5B. Sources Of Pollution

PERSISTENT ORGANOCHLORINE AND CURRENT USE INSECTICIDE CONCENTRATIONS IN MAJOR WATERSHED COMPONENTS OF MOON LAKE, MISSISSIPPI, USA.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
C. M. Cooper.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 1, p 103-113, March 1991. 2 fig, 3 tab, 19 ref.

Descriptors: *Agricultural chemicals, *Agricultural runoff, *Bioaccumulation, *Fate of pollutants, *Insecticides, *Nonpoint pollution sources, *Organochlorine pesticides, *Path of pollutants, DDD, DDE, DDT, Fenvalerate, Fish, Lake sediments, Methyl parathion, Mississippi, Moon Lake, Permethrins, Soil types, Surface water, Tissue analysis, Toxaphenes, Wetlands.

Concentrations of persistent insecticides DDT, DDD, DDE and toxaphene were compared with three currently used insecticides (fenvalerate, permethrin, and methyl parathion) in major watershed components of Moon Lake, Mississippi, and its 166 sq km watershed. Moon Lake (10.1 sq km), an oxbow of the Mississippi River, receives drainage through a series of wetlands from farmland intensively cultivated in cotton, soybeans, and rice. All watershed components were contaminated by DDT. Ten years after being banned, DDT was present in soil, wetland and lake sediments, surface water, and fish. Residual concentrations were significantly higher in aqueous/sediment phases of surface waters during the winter/spring wet season than during the dry season. This period of maximum runoff corresponded to minimum ground cover and maximum soil disturbance. Increased concentrations during periods of runoff emphasizes the magnitude of the DDT source that remains in soil (369 micrograms/kg) and indicates the importance of watershed management practices on long-term water quality. Current use insecticides were not detected in soils. In other watershed components, they were found less frequently, more sporadically, and in lower concentrations than persistent insecticides. However, the detection of these acutely toxic insecticides, especially methyl parathion, in fish tissue showed that these insecticides have sufficient persistence for uptake and, perhaps, bioaccumulation. (Author's abstract)
W91-11619

LIKELY EFFECTS OF SALINITY ON ACUTE COPPER TOXICITY TO THE FISHERIES OF THE LAKE GEORGE-EDWARD BASIN.
Uganda Freshwater Fisheries Research Organization, Jinja.
For primary bibliographic entry see Field 5C.
W91-11624

COASTAL MARINE ECOSYSTEMS OF MAURITIUS.
Mauritius Univ., Reduit. School of Agriculture.
For primary bibliographic entry see Field 2L.
W91-11626

HYDROLOGIC PROCESSES IN A SOUTHERN ONTARIO WETLAND.
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 2H.
W91-11636

CADMIUM, COPPER AND LEAD IN AQUATIC MACROPHYTES IN SHOAL LAKE (MANITOBA-ONTARIO).
Winnipeg Univ. (Manitoba). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-11637

LEAKAGE FROM TWO CONCRETE MANURE TANKS.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
S. F. Barrington, J. Denis, and N. K. Patni.
Canadian Agricultural Engineering CAEOAI, Vol. 33, No. 1, p 137-141, January 1991. 4 fig, 3 tab, 8 ref.

Descriptors: *Concrete construction, *Groundwater pollution, *Leakage, *Manure tanks, *Storage reservoirs, *Storage tanks, *Water pollution sources, Animal wastes, Construction joints, Water level, Water table.

Two 70 cu m in-ground concrete tanks were tested to determine their leakage rate to groundwater and liquid slurries. These tanks had been built with no special precautions to seal the joints between the floor and the walls. Leakage rates reached levels of 175 L/sq m/d under hydraulic pressures of 0.75 m created by high groundwater tables, but leakage rates fell to 3.5 L/sq m/d when the tanks were filled with water some 2.0 m above the groundwater table. When the tanks were filled with 1.65 to 2.0 m of dairy manures diluted to 1% and 3% total solids, leakage rates fell to 0.65 L/sq m/d. The design of concrete storage facilities exposed to high groundwater tables should include the sealing of joints; otherwise, extensive leakage can occur. Following the entry of large quantities of water into a reservoir already containing some manure, the seepage rate out of the tank may be very slow. Thus the sealing of the wall-floor joints, for example, may not be an environmental criteria but rather a method of saving storage space for manures. If the structure's joints are sealed, drainage mechanisms have to be used around the reservoir to control hydraulic pressures exerted by high groundwater levels. (Sand-PTT)
W91-11650

SULPHUR AND OXYGEN ISOTOPES BEHAVIOUR IN SULPHATES OF ATMOSPHERIC GROUNDWATER SYSTEM OBSERVATIONS AND MODEL.

Marie Curie-Sklodowska Univ., Lublin (Poland).
A. Trembaczowski.
Nordic Hydrology NOHYBB, Vol. 22, No. 1, p 49-66, 1991. 11 fig, 8 tab, 21 ref.

Descriptors: *Acid rain, *Groundwater pollution, *Precipitation, *Sulfates, *Water pollution sources, Atmospheric chemistry, Oxygen isotopes, Sulfur bacteria, Sulfur isotopes.

Comparison of sulfate concentrations in groundwater and atmospheric precipitation suggests that about 30% of groundwater sulfate may be of atmospheric origin. Another source of sulfate is the oxidation of sulfur compounds by microorganisms in the soil or aquifer. The sulfates of atmospheric and biogenic origin are mixed in the soil and subsequently the mixture gets into the groundwater. The delta-S-34 data suggest that delta-S-34 of biogenic sulfates is the same as that of atmospheric sulfates. Processes such as the assimilation of sulfates by plants, their decay and oxidation of organic compounds do not change the delta-S-34 significantly. Significant differences between delta-O-18 values of sulfates of atmospheric and biogenic origin, which are created by microbiological sulfur oxidizing processes, may be useful for interpretation of the processes in the groundwater system. (Author's abstract)
W91-11660

EQUILIBRIUM SPECIATION MODELS FOR HG, CD, AND PB IN THE GULF OF BOTHNIA AND ITS CATCHMENT AREA.
Umea Univ. (Sweden). Dept. of Inorganic Chemistry.
L. Gunneriusson, and S. Sjoberg.
Nordic Hydrology NOHYBB, Vol. 22, No. 1, p 67-80, 1991. 3 fig, 3 tab, 30 ref.

Descriptors: *Cadmium, *Chemical speciation, *Gulf of Bothnia, *Heavy metals, *Lead, *Mercury, *Model studies, *Path of pollutants, *Wetlands, Bogs, Computer models, Hydrogen ion concentration, Rivers, Salinity, Seawater, Thermodynamics.

Equilibrium speciation models were established for Hg(I), Cd(II) and Pb(II) in bog-, river-, and seawater having a composition corresponding to that of the Gulf of Bothnia (6 ppt salinity). The calculations were performed using the computer program SOLGASWATER. The models were based on available thermodynamic data at 25 C and included the inorganic ligands OH(-), Cl(-), Br(-), HPO4(2-) and CO2(aq). Complex formation with organic substances originating from a bog water was considered, and Mg(II) and Ca(II) were also included as competing cations. All water types were assumed to be oxic and in equilibrium with atmospheric CO2. The calculations showed that the speciation of Hg(II) and Pb(II) in bog and river waters is dominated by complexation with the organic substance, except for Pb(II), where the Pb(2+) ion dominates at pH < or = 5. In the Gulf of Bothnia, the chloro complexes HgCl2 and HgCl3(-) become prevailing as the salinity increases. Besides Pb(2+), the species PbCl(+) and PbCO3 become important with increasing salinity and pH. The dominating fraction of Cd(II) is Cd(2+) in bog water, in river water and in waters of salinity lower than 4.5 ppt. With increasing salinity CdCl(+) and CdCl2 predominate. (Author's abstract)
W91-11661

NEOPLASMS AND NONNEOPLASTIC LIVER LESIONS IN WINTER FLOUNDER, PSEUDOPLEURONECTES AMERICANUS, FROM BOSTON HARBOR, MASSACHUSETTS.
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
For primary bibliographic entry see Field 5C.
W91-11664

CARCINOGENS AND CANCERS IN FRESHWATER FISHES.
Roswell Park Memorial Inst., Buffalo, NY.
For primary bibliographic entry see Field 5C.
W91-11665

CONCENTRATIONS OF ORGANIC CONTAMINANTS IN MOLLUSKS AND SEDIMENTS AT NOAA NATIONAL STATUS AND TREND SITES IN THE COASTAL AND ESTUARINE UNITED STATES.
National Oceanic and Atmospheric Administration, Rockville, MD. Ocean Assessments Div.
T. P. O'Connor.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 69-73, 1991. 4 fig, 12 ref.

Descriptors: *Data acquisition, *Estuaries, *Mollusks, *National Status and Trends Program, *Organic compounds, *Organic pollutants, *Path of pollutants, *Sediment contamination, Bottom sampling, Coastal environment, DDT, Polychlorinated biphenyls.

The National Status and Trends (NST) Program of the National Oceanic and Atmospheric Administration (NOAA) monitors chemical contamination and biological responses to contamination in the coastal and estuarine United States. The program has two main parts: the Benthic Surveillance Project and the Mussel Watch Project. Benthic surveillance began in 1984 with the collection of surface sediments and benthic fish at 50 sites around the United States, and mussel watch began in 1986 with the collection of bivalve mollusks (mussels and oysters) and surface sediments at 150 sites. Since then, more sites have been added to each project. Data on concentrations of 17 elements and 50 organic compounds have been obtained in mollusks on an annual basis and on a less frequent basis in fish livers and surface sediments. Mean concentrations of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and DDT in mollusks and sediments at sites in the NST Program were found to be distributed in log-normal fashion. The dry weight-based chlorinated organic concentrations in mollusks generally exceeded those in nearby sediments by an order of magnitude. PAHs were found at similar concentrations in sediments and mollusks. High concentrations of PCBs and DDT in mollusks ranged from 1000 to 4000 ng/g(dry) and 400 to 1000 ng/g(dry), respectively; high PAH concentrations in sediments were 10,000 to 50,000 ng/g(dry). While higher concentrations of contaminants can be found by sampling localized hot spots, the NST data represent the distribution of concentrations over general areas of the coastal United States. (Feder-PTT)
W91-11669

BIOGEOCHEMICAL PROCESSES GOVERNING EXPOSURE AND UPTAKE OF ORGANIC POLLUTANT COMPOUNDS IN AQUATIC ORGANISMS.
Massachusetts Univ. at Boston. Environmental Science Program.
J. W. Farrington.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 75-84, 1991. 5 fig, 5 tab, 99 ref.

Descriptors: *Aquatic environment, *Bioaccumulation, *Biogeochemistry, *Coasts, *Literature review, *Organic compounds, *Path of pollutants, *Pesticides, *Polychlorinated biphenyls, Aromatic compounds, Biochemistry, Desorption, Food chains, Mathematical models, Mathematical studies, Physiology, Risk assessment, Sorption.

This literature review article of a few advances in biogeochemical research concerned with the movement of organic chemicals through aquatic ecosystems, conditions of exposure, and routes of up take by aquatic organisms, focuses mainly on nonpolar, hydrophobic, medium molecular weight compounds such as PCBs, chlorinated pesticides, and aromatic compounds. These compounds are generally found in fossil fuels and their combustion products, and are often identified in discussions about the current concern of human health risks associated with chemical contaminants in fish and other aquatic species. Factors which influence bioavailability and disposition (e.g., organism-water partitioning, uptake via food, food web transfer) include: solubilities; partitioning of chemicals between solid surfaces, colloids, and soluble phases; variables rates of sorption/desorption; and the physiological status of an organism. Predictive equations have been derived or have evolved empirically that tie molecular structural characteristics or properties to biogeochemical behavior. Coupling of the portions of biogeochemical models that deal with transfer back to people via consumption of living aquatic resources and potential impacts on human populations, e.g., consumption of carcinogens in edible portions of fish tissues, presents an important and powerful tool for realistic regulation of pollution for the protection of human health. However, caution must be exercised that the elegance and complexity of a series of coupled mathematical equations does not evoke a false sense that accurate predictive capabilities of wide-ranging applicability are a proven reality in either the scientific community or in the policy, regulation, and management communities concerned with aquatic pollution problems. (Feder-PTT)
W91-11670

RELATIVE ROLES OF METABOLISM AND RENAL EXCRETORY MECHANISMS IN XENOBIOTIC ELIMINATION BY FISH.
National Inst. of Environmental Health Sciences, Research Triangle Park, NC.
J. B. Pritchard, and J. R. Bend.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 85-92, 1991. 4 fig, 7 tab, 13 ref.

Descriptors: *Fish physiology, *Flounders, *Metabolism, *Path of pollutants, *Toxic wastes, *Toxicology, Benzopyrene, Bioaccumulation, Biochemistry, Fate of pollutants, Fish, Food chains, Kidneys, Polycyclic aromatic hydrocarbons, Water pollution effects.

Renal clearance techniques were used to examine the relative contributions of metabolism and renal tubular transport in determining the rates of excretion of benzo(a)pyrene(BaP) and several of its phase I metabolites by the southern flounder, Paralichthys lethostigma. Each compound (tritium-labeled) was injected at a dose of 2.5 micromole/kg, producing plasma concentrations of 1 to 5 microM. Despite extensive plasma binding (>95%), the uncorrected renal clearance of BaP-7,8-dihydrodiol exceeded the glomerular filtration rate (GFR) by more than 20-fold. Phenolic BaP metabolites also showed net secretion (1.5-to 3-fold). At times prior to 3 hour, BaP itself showed an average clearance of only 0.2 times the GFR. After 3 hour, BaP clearance increased to three times the GFR. Decreasing the dose of BaP injected dramatically increased its clearance. Clearances of all four compounds studied were reduced by probenecid and other organic anions, including the herbicide 2,4-dichlorophenoxyacetic acid. High performance liquid chromatographic analysis demonstrated that the bulk of the material excreted in the urine was not the parent compound, but sulfate or glucuronide conjugates of its phenolic or dihydrodiol metabolites. The rapid excretion of BaP-7,8-dihydrodiol reflected a combination of two processes: (1) that the metabolite was rapidly converted to its sulfate conjugate, primarily via extrarenal tissues; and (2) that the sulfate conjugate was preferentially transported to the urine via secretion on the organic anion transport system. (Feder-PTT)
W91-11671

DISPOSITION OF XENOBIOTIC CHEMICALS AND METABOLITES IN MARINE ORGANISMS.
National Marine Fisheries Service, Seattle, WA. Northwest Fisheries Center.
U. Varanasi, and J. E. Stein.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 93-100, 1991. 4 fig, 3 tab, 33 ref.

Descriptors: *Biotransformation, *Bottom sediments, *Carcinogens, *Path of pollutants, *Sediment contamination, *Toxicology, Fate of pollutants, Fish physiology, Food chains, Marine environment, Metabolism, Polycyclic aromatic hydrocarbons, Public health, Risk assessment, Tissue analysis.

Studies with several bottom fish species from urban waterways show that of the identified xenobiotic chemicals in bottom sediments, polycyclic

aromatic hydrocarbons (PAHs) are the most strongly associated with the prevalence of liver lesions, including neoplasms. Accordingly, there is concern about the transfer of contaminants from aquatic species. Because PAHs exert their toxicity only after being biotransformed, increasing attention has focused on the ability of aquatic organisms to metabolize these chemicals. Results of both laboratory and field studies show that generally low levels (nanograms per gram wet weight) of a few low molecular weight PAHs may be present in edible tissue of fish from contaminated areas, and that high molecular weight PAHs will rarely be detected because of extensive metabolism. Results from additional studies suggest that even though interactions between xenobiotics can affect both biochemical and physiological systems to alter the disposition of PAHs in fish, these interactions do not markedly change the relative proportions of metabolites to parent PAH in tissues. These studies clearly demonstrate that to obtain some insight into the questions of whether there is any risk to human health from consuming fish and crustaceans from urban areas, techniques must be developed that measure metabolites of carcinogens, such as PAHs, in edible tissues of fish and crustaceans from many urban areas. Further refinement in methodology leading to the identification of specific compounds may be needed because certain metabolites may not be as toxic or carcinogenic as others. (Author's abstract)
W91-11672

CYTOCHROME P-450 MONOOXYGENASE SYSTEMS IN AQUATIC SPECIES: CARCINOGEN METABOLISM AND BIOMARKERS FOR CARCINOGEN AND POLLUTANT EXPOSURE.
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W91-11673

EFFECTS OF A PLUME FRONT ON THE DISTRIBUTION OF INORGANIC AND ORGANIC MATTER OFF THE RHONE RIVER.
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 2L.
W91-11691

INTERPRETATION OF THE SEASONAL VARIATIONS OF NUTRIENTS IN A MEDITERRANEAN LAGOON: ETANG DE THAU.
Departement Sciences de l'Environnement et Sante Publique URA CNRS 1355, Faculte de Pharmacie Av., Charles Flahault, 34060 Montpelier, France.
For primary bibliographic entry see Field 2L.
W91-11693

DAILY CYCLES OF DISSOLVED OXYGEN AND NUTRIENT CONTENT IN A SHALLOW FISHPOND: THE IMPACT OF WATER RENEWAL.
Bordeaux-1 Univ., Talence (France). Inst. de Biologie Marine.
For primary bibliographic entry see Field 2H.
W91-11696

STUDY OF THE RIA FORMOSA ECOSYSTEM: BENTHIC NUTRIENT REMINERALIZATION AND TIDAL VARIABILITY OF NUTRIENTS IN THE WATER.
Instituto Nacional de Investigacao das Pescas, Olhao (Portugal). Centro Regional de Investigacao Pesqueira.
For primary bibliographic entry see Field 2L.
W91-11697

DISTRIBUTION OF MICROAEROPHILIC BACTERIA THROUGH THE OXIC-ANOXIC TRANSITION ZONE OF LAGOON SEDIMENTS.
Centre Univ. de Luminy, Marseille (France).
For primary bibliographic entry see Field 2L.
W91-11698

IN SITU BIOCHEMICAL AND BACTERIAL VARIATION OF SEDIMENTS ENRICHED WITH MUSSEL BIODEPOSITS.
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 2L.
W91-11699

VARIATION OF NUTRIENT STOCKS IN THE SUPERFICIAL SEDIMENTS OF LAKE GENEVA FROM 1978 TO 1988.
Institute F.-A. Forel, 10 route de Suisse, CH-1290 Versoix, Switzerland.
For primary bibliographic entry see Field 2H.
W91-11700

PHOSPHORUS MOBILITY IN INTERSTITIAL WATERS OF SEDIMENTS IN LAKE KINNERET, ISRAEL.
Bayreuth Univ. (Germany, F.R.). Limnologische Station.
For primary bibliographic entry see Field 2H.
W91-11701

POREWATER CHEMISTRY OF INORGANIC NITROGEN COMPOUNDS IN THE EASTERN SKAGERRAK (NE NORTH SEA).
Hamburg Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.
For primary bibliographic entry see Field 2L.
W91-11702

INCIDENCE OF MUSSEL CULTURE ON BIOGEOCHEMICAL FLUXES AT THE SEDIMENT-WATER INTERFACE.
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 2L.
W91-11703

METAL EXCHANGES IN THE FAUNA-SEDIMENT SYSTEM: THE CASE OF NEREIS DIVERSICOLOR AND SCROBICULARIA PLANA IN THE BOU REGREG ESTUARY (MOROCCO).
Cadi Ayyad Univ., Marrakech (Morocco). Dept. de Biologie.
M. Cheggour, H. Texier, G. Moguedet, and B. Elkaim.
Hydrobiologia HYDRB8, Vol. 207, p 209-219, November 22, 1990. 6 fig, 3 tab, 20 ref.

Descriptors: *Bioaccumulation, *Bioindicators, *Estuaries, *Metals, *Mollusks, *Morocco, *Path of pollutants, *Polychaetes, *Trace metals, *Wastewater pollution, Animal physiology, Aquatic animals, Chromium, Copper, Iron, Manganese, Nickel, Vanadium, Wastewater, Zinc.

The types and quantities of metals retained by Nereis diversicolor and Scrobicularia plana, two species selected as bioindicators, are investigated in a predominantly arid estuary environment. Certain abiotic parameters and a number of physiological processes linked to metabolic and reproductive functions play a decisive role in the seasonal influence of metal levels on the tissues of these organisms. Given the deposivoric diet of these organisms, the sedimentary bed would appear to be the principal source of metal accumulation. Zinc accumulated heavily and greater in Nereis than in Scrobicularia. Noticeable accumulation of copper, nickel and chromium, in the order Cu>Ni=Cr was observed in Scrobicularia more than in Nereis. Lesser accumulation of lead and manganese, in the order Pb>Mn, was equal in both genera. Light accumulation of vanadium and iron (V>Fe) was seen more in Scrobicularia than in Nereis. The possibility that these metals may be carried into the estuary by sewage water from the cities of Rabat and Sale should certainly not be ignored. (Author's abstract)
W91-11705

DYNAMICS OF CARBON ASSIMILATION BY ST. LAWRENCE ESTUARY PHYTOPLANKTON AT THE END OF SUMMER.
Laboratoire Arago, Banyuls-sur-Mer (France).
For primary bibliographic entry see Field 2L.
W91-11707

ORGANIC MATTER DISTRIBUTION IN BURROWS OF THE THALASSINID CRUSTACEAN CALLICHIRUS LAURAE, GULF OF AQABA (RED SEA).
Nice Univ. (France). Groupe de Recherches de Sedimentologie et Geochronologie Marines.
For primary bibliographic entry see Field 2L.
W91-11712

BIOGEOCHEMISTRY OF ORGANIC MATTER IN LAKE GENEVA: I--PARTICULATE HYDROCARBONS AS BIOGENIC AND ANTHROPOGENIC MOLECULAR MARKERS.
Paris-6 Univ. (France). Lab. de Physique et Chimie Marines.
For primary bibliographic entry see Field 2H.
W91-11718

MEASUREMENT OF THE LONGITUDINAL DISPERSION COEFFICIENT NEAR A JUNCTION IN A TIDAL RIVER.
Queensland Univ., Brisbane (Australia). Dept. of Physics.
For primary bibliographic entry see Field 2E.
W91-11737

TWO-DIMENSIONAL MODELING OF ADVECTION-DOMINATED SOLUTE TRANSPORT IN GROUNDWATER BY THE MATCHED ARTIFICIAL DISPERSIVITY METHOD.
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
D. Syriopoulou, and A. D. Koussis.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 865-872, May 1991. 12 fig, 3 tab, 28 ref. USGS Grant 14-08-0001-G1296.

Descriptors: *Advection, *Dispersivity, *Groundwater pollution, *Groundwater transport, *Model studies, *Path of pollutants, *Solute transport, Algorithms, Camp Borden Site, Chlorides, Model testing, Numerical analysis, Ontario, Plumes, Prediction.

Numerical prediction of the movement of contaminants is indispensable in assessing the extent of groundwater pollution and the effectiveness of remedial action scenarios. Frequently, however, the numerical work is complicated by the presence of steep fronts; these are pronounced near sources and early in the plume evolution and characterize advection-dominated transport. A methodology was developed for modeling, in two dimensions, the transport of dissolved constituents in steady groundwater flow. The model aims at the efficient confrontation of the difficulties associated with advection-dominated conditions (oscillation-free resolution of sharp fronts). Employing a spatial splitting algorithm within the framework of the (curvilinear) principal directions of transport formulation, it computes transport along streamlines by a variant of the pseudoviscosity method. Analytical tests confirm the model's accuracy. Comparisons with state-of-the-art models underscore its efficiency and its ability to resolve plumes formed under conditions of extreme dispersive contrasts. The model's structure permits implementation of PCs with grids suitable for field problems. Although the model lacks absolute generality, its validity is wide enough to merit consideration in practice. This is shown by an overall satisfactory simulation of the chloride plume observed under the Borden landfill in Ontario, Canada. (Doria-PTT)
W91-11740

MODELING THE HYDROGEOCHEMICAL RESPONSE OF A STREAM TO ACID DEPOSITION USING THE ENHANCED TRICKLE-DOWN MODEL.
Connecticut Univ., Storrs. Dept. of Civil Engineering.
N. P. Nikolaidis, P. K. Muller, J. L. Schnoor, and H. L. Hu.

Research Journal of the Water Pollution Control Federation RJWFE7, Vol. 63, No. 3, p 220-227, May/June 1991. 7 fig, 2 tab, 22 ref. EPA Grant CR-812329-01-5.

Descriptors: *Acid rain effects, *Fate of pollutants, *Model studies, *Path of pollutants, *Sulfates, *Virginia, Flow regime, Geochemistry, Geohydrology, Neutralization, Seasonal variation, Sorption.

The enhanced trickle-down model was applied to White Oak Run, a second-order stream located in Shenandoah National Park in Virginia. Calibration of the model was performed using 5 years of field data. Simulation results indicate that 29% of the incoming sulfate is retained in the upper soil horizons and 22% is retained in the lower soil horizons. The alkalinity concentrations in the stream exhibited a seasonal variation, with increased values during low flow and decreased values during high flow. Ion exchange in the upper soil neutralized 39% of the incoming acidity and weathering accounted for 14% of the neutralization in the lower soil horizons. Long-term simulations indicated that White Oak Run is a delayed response system primarily due to high sulfate sorption capacity. Sulfate desorbed from the soils after 40 to 50 years, assuming no reductions in the current deposition. This has significant policy implications because reduction in deposition levels will not result in a quick recovery of the system. (Author's abstract)
W91-11758

ESTIMATION OF POLLUTANT LOADS WITH FUZZY SETS.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
C. Baffaut, and J. L. Chameau.
Civil Engineering Systems CESYEE, Vol. 7, No. 1, p 51-61, March 1990. 13 fig, 2 tab, 18 ref.

Descriptors: *Fuzzy mathematics, *Mathematical models, *Model studies, *Pollutant load, *Precision, *Urban runoff, Data interpretation, Runoff, Statistical models, Storm runoff.

Interest in runoff water quality models has increased with the concern about pollution caused by runoff from urban areas or critical sites such as construction or mining sites. Regression and build-up-wash-off models are commonly used procedures to estimate pollutant loads. These models are not accurate and predict loads which are often as much as 300% in error. An approach is presented to estimate pollutant loads and concentrations in runoff using fuzzy sets. The fuzzy sets method helps to estimate storm load values that reflect some of the modeling and physical uncertainties. These uncertainties include those caused by the discrete data, as well as the limitations concerning the processes implemented in Storm Water Management Model (SWMM) and the initial values of the parameters. The technique relies on the selection of parameters based upon past data and experience, followed by a calibration of the parameter considered most important, the build-up limit. When the model is calibrated, predictions for future events can be made efficiently and at low cost with the Left-Right (L-R) set technique. The method helps identify anomalies of the model as it points out differences in the build-up limit determined for the various calibration events. Anomalies can be caused by an incorrect estimation of the wash-off parameters and build-up exponent. In this case, additional calculations can be made to refine the estimates of these parameters. If this fails, there is a strong indication that the build-up-wash-off model is not applicable or sufficient for the watershed. Final membership functions of the calibrated values of the build-up limits have large L-R spreads for the commercial watershed in Florida which was studied. Calibration of the impervious case study area in Denver resulted in smaller spreads. This result is consistent with the difficulties encountered during previous calibrations and confirms that the build-up and wash-off processes included in the SWMM are limited for some watersheds. (Lantz-PTT)
W91-11784

MODELING NITRATE TRANSFERS IN HYDROLOGICAL SYSTEMS (MODELISATION DU TRANSFERT DES NITRATES DANS UN SYSTEME HYDROLOGIQUE).
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
Q. Z. Geng.
Houille Blanche HOBLAB, Vol. 1991, No. 1, p 23-36, 1991. 14 fig, 2 tab, 19 ref. English summary.

Descriptors: *Model studies, *Nitrates, *Path of pollutants, Aquifer systems, Groundwater movement, Groundwater pollution, Leaching, Soil contamination, Soil water.

A method was developed to model the transfer, and particularly the leaching, of nitrate in a hydrologic system such as a regional basin. Called MORELN, the model simulates the production and leaching of nitrates, and was built to calculate the nitrate flux percolating from soil into groundwater. MORELN uses a 'Coupled Model', which integrally simulates surface and groundwater flows as a water transfer model. A third model, NEWSAM was also employed for modeling nitrate migration within the aquifer system. Joint use of these three models gives a global description of nitrate transfer, taking into account both nitrate production in soils and their displacement in aquifers. Three examples of model application allowed the methodology to be tested, especially the MORELN model, on three different scales: in a lysimeter of several square meters, in a small experimental basin of several square kilometers, and finally in a regional hydrologic system of several hundred square kilometers. (Author's abstract)
W91-11789

CHROMIUM BEHAVIOUR IN THE CHANGJIANG RIVER ESTUARY AND ITS ADJACENT SEA AREA, (IN CHINESE).
Academia Sinica, Qingdao (China). Inst. of Oceanology.
H. Huang, and X. Pong.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 21, No. 6, p 571-577, November 1990. 10 fig, 9 ref. (English summary).

Descriptors: *Changjiang River, *China, *Chromium, *Coastal waters, *Estuaries, *Path of pollutants, Chemical speciation, Huangpu River, Salinity, Seasonal variation.

Chromium content in the Changjiang estuarine area is higher than that in outer areas, but decreases with an increase in the distance off the estuary in August and November 1985, March 1986, and April 1987. This reflects the general trend of chromium transport in the Changjiang and Huangpu Rivers. In the dry season, water with low levels of chromium stretched to the shore at 31 deg 30 min N. Particulate chromium is the predominant species in sea water in this area. However, this is not the case in the summer when the total dissolved chromium and trivalent chromium are the principal species; hexavalent chromium is only a secondary species. The transfer of particulate chromium in summer and autumn occurred in only the lower salinity regions. (Author's abstract)
W91-11801

BOREHOLE SUMMARY REPORT FOR FIVE GROUND-WATER MONITORING WELLS CONSTRUCTED IN THE 1100 AREA.
Battelle Pacific Northwest Labs., Richland, WA.
R. W. Bryce, and S. M. Goodwin.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89 012219. Price codes: A11 in paper copy, A01 in microfiche. Report PNL--6824, May 1989. 231 p, 2 fig, 2 ref, 8 append. Contract DE-AC06-76RLO 1830.

Descriptors: *Groundwater pollution, *Groundwater quality, *Monitoring wells, *Path of pollutants, *Washington, *Waste disposal, *Water pollution sources, Boreholes, Drillers logs, Drilling, Drinking water, Pollutant identification, Water analysis, Well logs.

The Hanford Site, operated for the U.S. Department of Energy (DOE) by Westinghouse Hanford Company, consists of several areas that accommodate various activities. The 1100 Area, one of the areas near the city of Richland, Washington, has been used for maintenance activities, and waste disposal sites in the area have received unknown quantities of liquid and solid waste between 1959 and 1985, including spent battery acid, antifreeze, used motor oils, solvents, degreasers, paints, and paint thinners. Because of the proximity of these disposal sites to wells that supply water to Richland, five monitoring wells were installed in October 1988 to provide for early detection of contaminants and to provide data that may be used in making decisions on the management of the North Richland Well Field and recharge basins. The data gathered during the construction of the monitoring wells and the analytical results of the initial sampling of groundwater from the wells has been compiled. The wells were installed by cable tool through silty sandy gravels and gravelly sands at total depths ranging from 61.75 to 95 feet, using 4-inch stainless steel casing and screen, developed by removal of water, and sampled in November 1988. The groundwater samples analyzed by a testing company in the laboratory indicated results below those allowable under drinking water standards, while those analyzed by gas chromatography/electron capture detection/flame ionization detector showed trace concentrations of several volatile organic constituents, although well below the maximum contaminant level identified by the U.S. Environmental Protection Agency. (Fish-PTT)
W91-11828

SHORT-TERM TRENDS AND SPATIAL VARIABILITY IN PRECIPITATION CHEMISTRY IN THE SOUTH COAST AIR BASIN.
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
M. R. Hoffmann.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-167944. Price codes: A09 in paper copy, A01 in microfiche. Final Report for The California Air Resources Board, 28 February 1989. 180 p, 68 fig, 23 tab, 59 ref. Contract Number A4-142-32.

Descriptors: *Acid rain, *Air pollution, *California, *Chemistry of precipitation, *Precipitation, *Rain, *Spatial distribution, *Water pollution sources, Aerosols, Ammonium, Calcium, Chlorides, Cloud liquid water, Coasts, Ions, Magnesium, Nitrates, Nitrogen, Sodium, Storms, Sulfates, Sulfur, Water sampling.

Automated sub-event sequential rain samplers were used to sample rain during the winter and spring of 1987 in California's South Coast Air Basin. The highest rainwater concentrations of NO3(-) and SO4(-2) were observed at Pasadena; highest NH4(+) levels were measured at Riverside; highest average levels of rainwater Na(+) and Cl(-) were found at West Los Angeles. Rainfall concentration data from the 'vertical' profile indicate that much of the ionic loading in the rain at Henninger Flats (elev. 700 m) was picked up between there and Mt. Wilson (1700 m), while much of the ionic loading in the rain at Pasadena (200 m) was picked up between there and Henninger Flats. Measurements of the atmospheric burdens of aerosol and gas phase species prior to a storm indicated that considerably more N(V) and S(VI) were deposited in rainfall than could be accounted for by pre-storm atmospheric burdens of these species. The aerosol at elevated sites in the South Coast air basin is a mixture of sea salt and pollution-derived secondary aerosol. Comparisons of the ionic concentrations in two size-segregated fractions collected during each sampling interval suggest that there is a large difference between the average composition of the smaller droplets and that of the larger droplets; for each time interval, the concentration of Na(+), Ca(+2), and Mg(+2) in the large droplet fraction was observed to be higher than in the small droplet fraction, while the concentrations of SO4(-2), NO3(-), NH4(+), and H(+) were higher in the small droplet fraction. Differences in the composition of size-fractionated cloudwater samples suggest that large droplets are formed from sea salt and soil dust (large aerosol), and small droplets are formed on small secondary

aerosol composed primarily ammonium of sulfate and ammonium nitrate. (Fish-PTT)
W91-11829

EVALUATION OF WATER RESOURCES OF ORANGE AND EASTERN JEFFERSON COUNTIES, TEXAS.
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 2F.
W91-11834

ENVIRONMENTAL SURVEILLANCE DATA REPORT FOR THE FOURTH QUARTER OF 1988.
Oak Ridge National Lab., TN. Environmental and Occupational Safety Div.
T. J. Blasing, K. L. Daniels, P. Y. Goldberg, B. M. Horwedel, and I. L. McCollough.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89 015810. Price codes: A10 in paper copy, A01 in microfiche. Report No. ORNL/M--535, June 1989. 207 p, 23 fig, 93 tab. Contract No. DE-AC05-84OR21400.

Descriptors: *Environmental data, *Environmental monitoring, *Environmental quality, *Monitoring, *Nuclear energy, *Pollution load, *Sampling, *Water pollution sources, Air pollution, Groundwater pollution, Groundwater quality, Radioactive wastes, Soil contamination, Water pollution.

The Oak Ridge National Laboratory (ORNL) in Tennessee is responsible for environmental surveillance to ensure compliance with all federal, state, and Department of Energy (DOE) requirements for the prevention, control, and abatement of environmental pollution; monitor the adequacy of containment and effluent controls; and assess impacts of releases from ORNL facilities on the environment. A surveillance program has been implemented that includes sampling and monitoring of air, groundwater, water from surface streams and point sources, fish, milk, soil, and vegetation (grass) for radioactive and nonradioactive materials. Surveillance points are located on site to quantify discharges from ORNL facilities and off site to determine public exposures and to establish background reference levels. During the fourth quarter of 1988, over 2500 samples (>9200 analyses and measurements) were collected, and a network of real-time monitoring stations that telemeter 10-min averaged readings of radiation levels, total precipitation, flows, water quality parameters, and air quality parameters around the ORNL also reported data, as well as three meteorological towers that sent data at various heights to a host computer every 15 min. Radiation from long-lived airborne particulate radionuclides, external gamma radiation, cesium-137, flow-weighted concentrations of radionuclides in surface water, polychlorinated biphenyls (PCBs) in surface water and sediment, 131-iridium and radioactive strontium in milk, mercury and PCBs in streamwater and fish, and radionuclides in soil and grass samples from around ORNL and at remote sites were all found to be within government-regulated guidelines. Groundwater samples from some of the perimeter and characterization wells were notably high in tritium and radioactive strontium. October tritium concentrations in some surface water exceeded guidelines by 20%. (Fish-PTT)
W91-11848

SOURCES AND AREAL DISTRIBUTION OF TRACE METALS IN RECENT SEDIMENTS OF MIDDLE LOCH, PEARL HARBOR (HAWAII).
Oak Ridge National Lab., TN. Environmental Sciences Div.
T. L. Ashwood, C. R. Olsen, and I. L. Larsen.
Available from the National Technical Information Service, Springfield, VA 22161, as DE89 012817. Price codes: A04 in paper copy, A01 in microfiche. Report No. ORNL/TM--11135, May 1989. 67 p, 10 fig, 8 tab, 14 ref, 3 append. Contract No. DE-AC05-84OR21400.

Descriptors: *Harbors, *Hawaii, *Heavy metals, *Pearl Harbor, *Sediment contamination, *Sediments, *Trace metals, *Water pollution sources, Copper, Lead, Pollution load, Sediment sampling, Sediment transport, Ships, Wastewater disposal, Zinc.

A study has been performed to determine if the U.S. Navy's Inactive Fleet operations in Pear Harbor, Hawaii currently are a significant source of trace metal contamination--a source which may have been masked by sewage discharges during previous studies. Sediment samples from ten locations within Middle Loch and from two locations in each of the two major streams entering the loch were analyzed for radioisotopes and metals. The presence of the natural, short-lived radioisotope Be-7 was used to identify sites where the sedimentary material was recently deposited and to identify patterns of recent sediment accumulation. High Be-7 inventories beneath the ships and at the mouths of the streams suggest that these are areas of rapid sediment accumulation, and suggests that Middle Loch effectively traps particle-reactive contaminants through sediment adsorption and deposition. Four sources of increases in copper (Cu), lead (Pb), and zinc (Zn) over historical levels were identified: (1) inactive ship maintenance and mooring operations contribute Cu, Pb, and Zn contamination to the sediments in the immediate vicinity of the inactive vessels; (2) freshwater streams carry sediment-bound trace metals into the shallow-water margin areas of the loch; (3) sediment disturbances associated with ship movements can expose or resuspend and redeposit buried material from past contamination events; and (4) wind-blown material contributes relatively little trace metal contamination. Average trace metal concentrations in recent Middle Loch sediments show no significant decline since the termination of direct sewage discharges in 1983 because streams continue to discharge trace metal contamination into the loch and sediment disturbances associated with mooring operations expose and/or resuspend buried sediments that contain high trace metal levels from past naval incidents and sewage discharges. (Fish-PTT)
W91-11849

1987 ENVIRONMENTAL MONITORING REPORT, SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NEW MEXICO.
Sandia National Labs., Albuquerque, NM. Environment, Safety, and Health Dept.
G. Millard, P. Pei, S. Felicetti, C. Gray, and D. Thompson.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88 010368. Price codes: A09 in paper copy, A02 in microfiche. Report No. SAND--88-0697, April 1988. 194 p, 9 fig, 111 tab, 36 ref, 9 append. Prepared for the U.S. Department of Energy in Compliance with USDOE Order 5484.1.

Descriptors: *Environmental monitoring, *Environmental quality, *Groundwater quality, *Monitoring, *New Mexico, *Path of pollutants, *Radioisotopes, *Water pollution sources, Air pollution, Cesium radioisotopes, Soil contamination, Tritium, Uranium radioisotopes, Vegetation, Water pollution.

Sandia National Laboratories Albuquerque (SNLA) is located south of Albuquerque, New Mexico, on Kirtland Air Force Base. Because radionuclides are potentially released in small quantities from its research activities, SNLA has a continuing environmental monitoring program which analyzes for cesium-137, tritium, uranium, alpha emitters, and beta emitters in water, soil, air, and vegetation. Measured radiation levels in public areas were consistent with local background in 1987. A total of 7.7 curies of argon-41 were released as a result of SNLA operations in 1987. The Albuquerque population received an estimated 0.058 person-rem from airborne radioactive releases, whereas it received greater than 44,100 person-rem from naturally occurring radionuclides. A nonradioactive effluent monitoring program has been started at SNLA which includes groundwater, stormwater, and sewage monitoring. Results indicate that groundwater quality conformed to USEPA drinking water standards. Preliminary testing of stormwater showed that no pollutants were above minimum detectable levels. A program to investigate potential remedial action sites has been started. (Fish-PTT)
W91-11854

BIOPLUME (BIODEGRADATION IN AQUIFERS AND DEVELOPING A MATHEMATICAL MODEL) FOR CONTAMINANT TRANSPORT AFFECTED BY OXYGEN LIMITED BIODEGRADATION.
Rice Univ., Houston, TX. Dept. of Civil Engineering.
H. S. Rifai, P. B. Bedient, and J. T. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB90-145798. Price codes: A02 in paper copy, A01 in microfiche. Report No. EPA/600/M-89/019, August 1989. 9 p, 6 fig, 1 tab, 19 ref. EPA Contract No. CR812808.

Descriptors: *Biodegradation, *Fate of pollutants, *Groundwater pollution, *Mathematical models, *Model studies, *Organic pollutants, *Path of pollutants, *Plumes, Anaerobic digestion, Hydrocarbons, Michigan, Microbial degradation, Microbial transport, Microbiological studies, Oxygen requirements, Oxygen transport, Texas.

Many of the organic pollutants entering the groundwater are potentially biodegradable in the subsurface. This potential has been demonstrated in aquifers contaminated by wood-creosoting process wastes and gasoline. The persistence of many of these organic compounds in the subsurface indicated that some factors must be limiting biodegradation. Current research has been aimed at identifying the major processes that limit biodegradation in aquifers and developing a mathematical model (BIOPLUME) for simulating these processes. In order to identify the rate limiting processes for biodegradation, the equations describing microbial growth and decay and transport of oxygen and contaminants were developed and solved in one and two dimensions. The main purpose of the research was to develop the mathematical tools necessary to describe and simulate the process of oxygen limited biodegradation of organics in groundwater. The model was applied at two sites, the United Creosote Company, Inc. site in Conroe, Texas, and an aviation gasoline spill site in Traverse City, Michigan. Field work at the Conroe, Texas, site indicated that oxygen was limiting the microbial degradation of dissolved hydrocarbons present in the shallow aquifer. At the Traverse City, Michigan site, model predictions for the rates of mass loss closely matched calculated rates from the field data. (Fish-PTT)
W91-11855

HYDROGEOLOGY AND PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR CONTAMINATION OF THE MEMPHIS AQUIFER IN THE MEMPHIS AREA, TENNESSEE.
Geological Survey, Memphis, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11860

HYDROGEOLOGY AND GROUND-WATER-QUALITY CONDITIONS AT THE LINN COUNTY LANDFILL, EASTERN KANSAS, 1988-89.
Geological Survey, Lawrence, KS. Water Resources Div.
R. Falwell, P. R. Bigsby, and N. C. Myers.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4117, 1991. 48p, 20 fig, 8 tab, 45 ref. Project No. USGS KS138.

Descriptors: *Groundwater pollution, *Kansas, *Landfills, *Leachates, *Linn County Landfill, *Path of pollutants, *Water pollution sources, Water quality.

An investigation of the hydrogeology and groundwater quality conditions near the Linn County Landfill, eastern Kansas was conducted from July 1988 through June 1989. The landfill is located in an unreclaimed coal strip-mine area near Prescott. Analysis of water levels from nine temporary wells

and from strip-mine ponds indicated that groundwater flows southwest through the present landfill. A county road west of the landfill acts as a barrier to shallow westerly groundwater flow. Seasonal variations in the direction of groundwater flow may occur. Water samples from monitoring wells and a strip-mine pond were analyzed for inorganic and organic compounds. Iron, manganese, and dissolved-organic-carbon concentrations were good indicators of the presence of landfill leachate in the groundwater. Benzene, carbon tetrachloride, 1,1-dichloroethane, and 1,1,1-trichloroethane were also detected. None of the inorganic or organic compounds detected exceeded Kansas primary drinking-water standards. Chemical concentrations and water levels in some nested wells indicate there is a hydraulic connection between the strip-mine spoil material and the underlying limestone. Leachate-contaminated groundwater has the potential to migrate southwest, west, or northwest from the southwest corner of the landfill through either strip-mine spoil material or through the underlying Pawnee Limestone. (USGS)
W91-11865

RECONNAISSANCE OF THE OCCURRENCE OF AGRICULTURAL CHEMICALS IN GROUND WATER IN HAYWOOD, LAKE AND OBION, AND SHELBY COUNTIES, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
D. W. Hanchar.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4064, 1991. 28p, 10 fig, 8 tab, 15 ref.

Descriptors: *Agricultural chemicals, *Groundwater pollution, *Nonpoint pollution sources, *Pesticides, *Tennessee, *Water quality, Fertilizers, Path of pollutants, Water pollution sources.

Shallow wells in Haywood, Shelby, and Lake and Obion Counties in West Tennessee were sampled during a reconnaissance of groundwater quality conducted by the U.S. Geological Survey in cooperation with the Tennessee Department of Health and Environment. Nineteen shallow wells completed in alluvial aquifers in areas of high density agricultural use were sampled during the winter and summer of 1988. Although no triazine herbicides or organophosphorus insecticides were detected in any of the wells sampled, elevated nitrite plus nitrate (as nitrogen) concentrations were detected. Results from the winter sampling period indicate a range of nitrite plus nitrate (as nitrogen) concentrations of less than 0.1 to 7.8 mg/L with a median concentration of 2.6 mg/L. Results from the summer sampling period indicate a range of nitrite plus nitrate as nitrogen concentrations of less than 0.1 to 8.9 mg/L, median, 2.5 mg/L. The highest of these concentrations occurred in the shallowest wells, and, in one instance, in a shallow well near a heavily irrigated field. (USGS)
W91-11866

DELINEATION OF GROUND-WATER CONTAMINATION USING SOIL-GAS ANALYSIS NEAR JACKSON, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
R. W. Lee.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4137, 1991. 9p, 3 fig, 6 ref.

Descriptors: *Oil spills, *Path of pollutants, *Soil gases, *Tennessee, *Water pollution sources, Gas chromatography, Gasoline, Leakage, Underground storage tanks, Volatile organic compounds.

An underground fuel-storage tank in Jackson, Tennessee, leaked about 3,000 gallons of unleaded gasoline from 1980 to 1988. The fuel leaked to the water table about 4 ft below land surface. A survey of soil gas showed concentrations of volatile organic compounds greater than 10,000 parts per million near the leak. The contaminants were detected in soil gases in an area about 240 ft long and 110 ft wide extending west from the point source. Two distinct 'fingerprints' of volatile organic compounds were observed in the chromatograms. Benzene, toluene, and xylenes, which are present in unleaded fuel, in addition to other volatile compounds, were detected in soil gas of the area near the fuel leak. Just north of the underground fuel-storage tank, however, other volatile organic compounds containing no detectable benzene, toluene, or xylenes were detected in soil-gas samples. Mapping of total concentrations of volatile organic compounds in soil gases of the unsaturated zone indicate that a second plume about 200 ft long and 90 ft wide, also extending to the west, was present about 100 ft north of the fuel leak. Previous activities on this site during the 1950's or earlier may have contributed volatile organic compounds to the second plume. Soil-gas analyses could be successfully deployed for mapping the size and location of volatile organic compound plumes in other sand and gravel aquifers where the depth to water is shallow. (USGS)
W91-11868

HYDROLOGIC AND WATER-QUALITY DATA FOR SELECTED SITES, GRAND TETON NATIONAL PARK, WYOMING, SEPTEMBER 1988 THROUGH SEPTEMBER 1990.
Geological Survey, Boise, ID.
For primary bibliographic entry see Field 2F.
W91-11869

EFFECTS OF SITE DISTURBANCE ON THE MOBILIZATION AND DISTRIBUTION OF NUTRIENTS AND TRACE METALS IN FOREST SOILS.
Maine Univ. at Orono. Dept. of Plant, Soil and Environmental Sciences.
For primary bibliographic entry see Field 2G.
W91-11880

MEASUREMENT OF SOIL STRUCTURE, WATER MOVEMENT AND SOLUTE TRANSPORT USING COMPUTED TOMOGRAPHY.
Missouri Univ., Columbia. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W91-11909

GEOLOGIC SETTING AND WATER QUALITY OF SELECTED BASINS IN THE ACTIVE COAL-MINING AREAS OF OHIO, 1987-88.
Geological Survey, Columbus, OH. Water Resources Div.
A. C. Sedam.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4109, 1991. 92p, 19 fig, 21 tab, 32 ref.

Descriptors: *Coal mines, *Coal mining effects, *Groundwater, *Ohio, *Surface water, *Water quality, Land reclamation.

Hydrologic data were collected from selected drainage basins in the active coal-mining areas of Ohio from July 1987 through October 1988. The study area is mostly within the unglaciated part of eastern Ohio along the western edge of the Appalachian Plateau's physiographic province. The 1987-88 work is the second phase of a 7-year study to assess baseline water quality in Ohio's coal region. The data collection network consisted of 41 long-term surface water sites in 21 basins. The sites were measured and sampled twice yearly at low flow. In addition, six individual basins (three each year) were selected for a more detailed representation of surface-water and groundwater quality. In 1987, the Sandy Creek, Middle Tuscarawas River and Sugar Creek, and Lower Tuscarawas River basins were chosen. In 1988, the Short and Wheeling Creeks, Upper Wills Creek, and Upper Raccoon Creek basins were chosen. Because of their proximity to the glaciated region and outwash drainage, the basins studied intensively in 1987 contain more shallow productive aquifers than do the basins studied in detail for 1988, in which shallow groundwater sources are very localized. Chemical analyses for 202 surface water and 24 groundwater samples are presented. For field measurements made at surface water sites, the specific conductance ranged from 295 to 3,150 microS/cm (microsiemens/cm at 25 C). For pH, the range was 2.8 to 8.6. Alkalinity ranged from 5 to 305 mg/L as CaCO3. (USGS)
W91-11919

EFFECTS OF OIL PRODUCTION ON WATER RESOURCES IN THE KENTUCKY RIVER BASIN, KENTUCKY.
Geological Survey, Reston, VA. Water Resources Div.
R. D. Evaldi, and J. A. Kipp.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4191, May 1991. 58p, 19 fig, 6 tab, 35 ref.

Descriptors: *Kentucky, *Oil, *Oil fields, *Path of pollutants, *Water pollution sources, Bromides, Chlorides, Dissolved solids, Ion transport, Ions.

As part of a comprehensive study of water quality in the Kentucky River basin, Kentucky, an area of intense oil-production activity was investigated. Groundwater sampling indicated that shallow groundwater in valley alluvial areas was probably not affected by oil-production activities, that water flooding had decreased the mineral content of water in the oil-production units but not in the overlying formations, and that the character of water in a shallow bedrock formation may reflect mixing of freshwater from the overlying alluvium and mineralized water from deeper units. Surface water from oil-production basins was determined to be a sodium chloride type water, differing from the calcium bicarbonate type water generally found in basins unaffected by oil production. The average annual yields of bromide, chloride, sodium, and strontium from one oil-production basin studied were at least 10 times greater than from a non-production basin. The largest concentrations of chloride and bromide in the Kentucky River downstream of the oil basins typically occur in the fall of the year, as precipitation and runoff increase following the dry late-summer months. Conceptually, these large concentrations are a result of the flushing of ionic constituents from the oil-production basins that have accumulated during the dry season. (USGS)
W91-11922

BACKGROUND CONCENTRATIONS OF SELECTED RADIONUCLIDES, ORGANIC COMPOUNDS, AND CHEMICAL CONSTITUENTS IN GROUND WATER IN THE VICINITY OF THE IDAHO NATIONAL ENGINEERING LABORATORY.
Geological Survey, Idaho Falls, ID. Water Resources Div.
B. R. Orr, L. D. Cecil, and L. L. Knobel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 91-4015, 1991. 52p, 17 fig, 2 tab. USGS Contract No. DE-AI07-81ID12306. USGS Project No. ID-165.

Descriptors: *Baseline studies, *Radioactive wastes, *Water pollution sources, *Water quality, Idaho, Idaho National Engineering Laboratory, Radiochemical analysis.

Background concentrations of radionuclides, organic compounds, and other chemical constituents in water in the Snake River Plain aquifer in Idaho were estimated from groundwater sample analyses. Detectable concentrations of transuranic elements should not be present in water from the Snake River Plain aquifer. Background concentrations of tritium generally range from 75 to 150 pCi/L. Strontium-90 and iodine-129 concentrations generally are 0 and from 0 to 0.05 pCi/L, respectively. At the INEL (Idaho National Engineering Laboratory), comparison of the mean and median concentrations of tritium, strontium-90, and iodine-129 indicates that operations locally have affected concentrations in groundwater. Gross alpha-particle and beta-particle radioactivity in water from the Snake River Plain aquifer ranges from 0 to 5 pCi/

L and 0 to 8 pCi/L, respectively. Background gamma radiation in groundwater is attributed to cesium-137, cobalt-60, and potassium-40. Cesium-137 and cobalt-60 concentrations generally are zero in groundwater at the INEL. Naturally occurring concentrations of potassium-40 probably are about 300 pCi/L. Background concentrations of organic compounds in water from the Snake River Plain aquifer generally are less than 0.2 microg/L. Background arsenic and chromium concentrations both are about 2 to 3 microg/L. Barium concentrations are from about 50 to about 70 microg/L. Lead and mercury concentrations generally are less than 5 microg/L and 0.1 microg/L, respectively. Cadmium, selenium, and silver concentrations generally are less than 1 microg/L. Nitrate concentrations range from 0 to about 1.4 mg/L. (USGS)
W91-11924

SURFACE WATER-QUALITY ASSESSMENT OF THE LOWER KANSAS RIVER BASIN, KANSAS AND NEBRASKA: CONCENTRATIONS OF MAJOR METALS AND TRACE ELEMENTS IN STREAMBED SEDIMENTS, 1987.
Geological Survey, Lawrence, KS. Water Resources Div.
D. Q. Tanner, R. F. Sanzolone, and R. B. Zelt.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-581, 1990. 73p, 3 fig, 6 tab, 5 ref. USGS Project No. KS152.

*Water pollution sources, *Metals, *Bottom sediments, *Kansas, *Nebraska, Heavy metals, Trace elements, Kansas River, Big Blue River, Water Quality.

During September and October 1987, streambed sediments were collected in the lower Kansas River basin of Kansas and Nebraska as part of the U.S. Geological Survey's National Water-Quality Assessment Program. During a reconnaissance survey, 422 samples were collected on first-order and second-order streams within the study area. Additionally, 62 streambed-sediment samples were collected along the main stem of the Big Blue, and Kansas Rivers and their major tributaries. The 62 samples were collected at least once every 50 stream miles and at sites where trace-element enrichment might be expected based on the location of point-source discharges for which National Pollutant Discharge Elimination System permits have been issued. The less-than 62-microm-sized, sediment graction was analyzed for 42 major metals and trace elements. In addition, the samples were analyzed for total carbon and carbonate carbon, phosphorus, and sulfer concentrations. The samples collected along the main streams and tributaries also were analyzed for clay content. For 10 of the 47 measured constitutents, a majority of sites had values that were considered 'qualified'; that is, the values were less than the lower level of detection for that particular analysis. Concentrations of the remaining constituents varied considerably, with aluminum, barium, iron, manganese, and phosphorus having the largest median concentrations. Concentrations of all constituents analyzed are presented and statistically summarized. (USGS)
W91-11927

GEOHYDROLOGIC FRAMEWORK AND AN ANALYSIS OF A WELL-PLUGGING PROGRAM, LEE COUNTY, FLORIDA.
Geological Survey, Fort Meyers, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11930

HYDROGEOLOGY AND QUALITY OF GROUND WATER IN THE BOONE FORMATION AND COTTER DOLOMITE IN KARST TERRAIN OF NORTHWESTERN BOONE COUNTY, ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
V. A. Leidy, and E. E. Morris.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4066, 1991. 57p, 13 fig, 9 tab, 45 ref.

Descriptors: *Arkansas, *Boone Formation, *Cotter Dolomite, *Groundwater movement, *Karst, *Nonpoint pollution sources, *Path of pollutants, *Water quality, Bacteria, Boone County, Contamination, Geochemistry, Geology, Manure, Rain, Seasonal variation, Shallow water, Springs, Wells.

Shallow groundwater flow systems in karst terrain of northwestern Boone County, Arkansas, are particularly susceptible to contamination. Possible sources of contamination include cattle manure, chicken manure, which commonly is applied to pastures as fertilizer, commercial fertilizers, and septic tank effluent. The potential for groundwater contamination probably is greater in the northern one-half of the study area where there are more photolineaments and presumably subsurface fractures. Groundwater samples from 17 springs discharging from the Boone Formation and 17 wells completed in the Cotter Dolomite were analyzed to determine ambient groundwater quality and to document water quality variations. The chemical constituents in groundwater generally did not exceed U.S. Environmental Protection Agency primary or secondary maximum contaminant levels. However, fecal coliform and fecal streptococcus bacteria wee detected in most springs and in three wells. One spring, located near an abandoned wood-treatment plant (a designated Superfund site), had maximum iron, manganese, lead, and pentachlorophenol concentrations that exceeded U.S. Environmental Protection Agency's primary or secondary maximum contamination levels for drinking water. Water samples collected from selected springs emerging from the Boone Formation exhibited an overall decrease (dilution effects) in specific conductance and total alkalinity, calcium, magnesium, sodium, and chloride concentrations and an overall increase (flushing effects) in nitrate, fecal coliform, and fecal streptococcus bacteria concentrations 3 to 8 hours after a rainstorm. Fecal coliform colonies in one spring increased from 27 to 25,000 colonies/100 ml after a rainstorm. (USGS)
W91-11931

GEOHYDROLOGY AND THE OCCURRENCE OF VOLATILE ORGANIC COMPOUNDS IN GROUND WATER, CULPEPER BASIN OF PRINCE WILLIAM COUNTY, VIRGINIA.
Geological Survey, Richmond, VA. Water Resources Div.
D. L. Nelms, and D. L. Richardson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4032, 1990. 94p, 20 fig, 15 tab, 62 ref.

Descriptors: *Culpeper Basin, *Geohydrology, *Groundwater pollution, *Path of pollutants, *Virginia, *Volatile organic compounds, *Water pollution sources, Fractured-rock aquifers, Geographic information systems, Prince William County, Virginia Piedmont.

The Culpeper basin of Prince William County comprises an interbedded sequence of Upper Triassic and Lower Jurassic sedimentary and volcanic rocks. This sequence is intersected by diabase intrusives and thermally metamorphosed rocks. The rocks of the Culpeper basin are highly fractured and overlain by a thin cover of overburden. Groundwater in the Culpeper basin flows generally from the uplands (recharge areas) along lineaments (linear-surface expressions of fracture sets) to the lowlands or valleys (discharge areas). Pumping from municipal-supply wells has caused two cones of depression in the Manassas-Manassas Park area. Volatile organic compounds have been detected in groundwater in 5 areas of the Culpeper basin in the county. The dominant volatile organic compounds detected are tetrachloroethylene, trichloroethylene, and 1,1,1-trichloroethane. Concentrations of the volatile organic compounds range from 0.1 to 5,300 microg/L. (USGS)
W91-11932

GROUND-WATER HYDROLOGY AND QUALITY IN THE VALLEY AND RIDGE AND BLUE RIDGE PHYSIOGRAPHIC PROVINCES OF CLARKE COUNTY, VIRGINIA.
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11933

GROUND-WATER LEVELS AND TRITIUM CONCENTRATIONS AT THE MAXEY FLATS LOW-LEVEL RADIOACTIVE WASTE DISPOSAL SITE NEAR MOREHEAD, KENTUCKY, JUNE 1984 TO APRIL 1989.
Geological Survey, Reston, VA. Water Resources Div.
K. S. Wilson, and B. E. Lyons.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4189, 1991. 217p, 24 fig, 9 tab, 13 ref.

Descriptors: *Groundwater pollution, *Path of pollutants, *Radioactive wastes, *Tritium, *Waste disposal, *Water level fluctuations, Kentucky, Louisville.

The Maxey Flats disposal site, Kentucky encompasses about 280 acres near the edge of a flat-topped ridge. The ridge is underlain by fractured shale and sandstone beds of the Nancy Member and the Farmers Member of the Borden Formation of Mississippian age. Groundwater flow in the strata beneath the site occurs through fractures, and flow patterns are difficult to delineate. The potentiometric surface also is difficult to delineate because several saturated and unsaturated zones are present in the rocks. Generally, ground-water levels in wells intersecting permeable fractures fluctuated seasonally and were lowest from December through June and highest from July through November. Water levels in the disposal trenches fluctuated less than those in wells, and for most trenches the fluctuations were less than 0.5 foot. From June 1984 to April 1989, tritium concentrations in groundwater ranged from 0 to 2,402,200 picocuries/ml. The greatest and most variable tritium concentrations were in wells along the northwest side of the site. The major conduit of groundwater flow from the trenches in the northwestern part of the site is a fractured sandstone bed that forms the base of most trenches. Elsewhere along the site perimeter, elevated levels of tritium were not detected in wells, and mean tritium concentrations showed little change between 1986 and 1988. (USGS)
W91-11936

CHEMICALS AND ISOTOPIC DATA FOR WATER FROM WELLS, SPRINGS, AND STREAMS IN CARBONATE-ROCK TERRAIN OF SOUTHERN AND EASTERN NEVADA, 1985-88.
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 2K.
W91-11939

WORK PLAN FOR REGIONAL RECONNAISSANCE FOR SELECTED HERBICIDES AND NITRATE IN GROUND WATER OF THE MID-CONTINENTAL UNITED STATES, 1991.
Geological Survey, Iowa City, IA. Water Resources Div.
D. W. Kolpin, and M. R. Burkart.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-59, 1991. 18p, 3 fig, 7 tab, 15 ref.

Descriptors: *Data acquisition, *Herbicides, *Network design, *Nonpoint pollution sources, Mid-continental United States, Monitoring, Nitrates, Water quality.

An approach was developed to obtain a consistent, regional distribution of herbicide and nitrate data from near-surface aquifers in the corn and soybean producing region of the mid-continent. Near sur-

face aquifers are defined as those with the top of aquifer material within 50 ft of land surface, regardless of whether the material is saturated or unsaturated. Three hundred wells will be selected for sampling from 12 states. These States include Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The reconnaissance data obtained will be used to determine the spatial and seasonal distribution of selected herbicides, two atrazine metabolites, and nitrate in near surface aquifers in the study region. Hydrologic, geologic, and land use data will be collected for use in an exploratory statistical analysis to help explain the herbicide distribution. (USGS)
W91-11941

HYDROLOGIC DATA FOR THE BIG SPRING BASIN, CLAYTON COUNTY, IOWA, WATER YEAR 1989.
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11943

WATER-QUALITY DATA, SAN JOAQUIN VALLEY, CALIFORNIA, APRIL 1987 TO SEPTEMBER 1988.
Geological Survey, Sacramento, CA. Water Resources Div.
L. R. Shelton, and L. K. Miller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-74, 1991. 189p, 4 fig, 2 tab, 21 ref.

Descriptors: *California, *Data collections, *Groundwater, *San Joaquin Valley, *Surface water, *Water quality, Streamflow.

Water quality data were collected at numerous surface-water and groundwater sites in the San Joaquin Valley, California, from April 1987 to September 1988. Streamflow was measured and water samples were collected for analysis of major ions, trace elements, suspended sediments, and some pesticides at 11 continuing-record sites on the San Joaquin River and major tributaries. Onsite measurements were made and water samples were collected for analysis of major ions, trace elements, and some pesticides at 163 groundwater sites in the western and southern San Joaquin Valley. (USGS)
W91-11944

WATER QUALITY OF FOUNTAIN AND MONUMENT CREEKS, SOUTH-CENTRAL COLORADO, WITH EMPHASIS ON RELATION OF WATER QUALITY TO STREAM CLASSIFICATIONS.
Geological Survey, Pueblo, CO. Water Resources Div.
P. Edelmann.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4132, 1991. 99p, 46 fig, 6 tab, 10 ref.

Descriptors: *Colorado, *Fountain Creek, *Monument Creek, *Water quality, Chlorides, Dissolved oxygen, Nutrients, Specific conductance, Sulfates, Trace constituents, Water temperature, pH.

The quality of water in Fountain and Monument Creeks in south-central Colorado was monitored from 1975 through 1983. The purpose of the monitoring program was to describe the general water quality characteristics of Fountain and Monument Creeks and to evaluate the water quality of each stream segment based on classifications established by the Colorado Department of Health in 1982. Most of the water quality constituents monitored during the investigation have numeric water quality data and were evaluated for seasonal, temporal, and spatial variations. In general, the concentrations of the physical and major inorganic constituents measured were less than the instream water quality standards. The concentrations of several trace elements exceeded the water quality standards. The trace elements that exceeded the water quality standards at various sampling sites included dissolved manganese, total selenium, and total-recoverable copper, iron, lead, manganese, silver, and zinc. The sources of these trace elements probably are the sedimentary rocks in the basin. However, discharges from mine tailings and wastewater-treatment plants also may cause increases in concentrations of certain trace elements. (USGS)
W91-11948

GEOHYDROLOGIC EVALUATION OF THE UPPER PART OF THE MESAVERDE GROUP, NORTHWESTERN COLORADO.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 4C.
W91-11949

HYDROLOGIC DATA FOR THE WELDON SPRING CHEMICAL PLANT SITE AND VICINITY PROPERTY, ST. CHARLES COUNTY, MISSOURI--1986-89.
Geological Survey, Rolla, MO. Water Resources Div.
J. J. Kleeschulte, and P. W. Cross.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-552, May 1991. 117p, 15 fig, 14 tab, 13 ref.

Descriptors: *Radioactive wastes, *Water pollution sources, *Weldon Spring Site, Burgermeister Spring, Water quality.

Hydrologic data collected during an investigation of the Weldon Spring chemical plant site and vicinity property in St. Charles County, Missouri, from May 1986 through September 1989, are presented. The data consist of water quality analyses of samples collected from 10 locations at the Weldon Spring chemical plant site. These sites were selected because they typically have increased concentrations of uranium. Water quality analyses from 57 wells, 19 springs, and 17 surface water sites also are included. This report also includes daily mean specific conductance values from July 1987 through September 1989 for Burgermeister spring, Frog pond outflow, and Ash pond outflow; daily mean discharges for Burgermeister spring from May 1986 through September 1989 and for the unnamed tributary containing Burgermeister spring at Twin Island Lake and for Schote Creek at U.S. Highways 40 and 61 from August 1987 through September 1989; daily values of total precipitation from June 1987 through September 1989; well-construction data; and water level measurements from May 1987 through August 1989. (USGS)
W91-11950

NEUTRAL OIL IN COMMERCIAL LINEAR ALKYLBENZENESULFONATE AND ITS EFFECT ON ORGANIC SOLUTE SOLUBILITY IN WATER.
Geological Survey, Denver, CO. Water Resources Div.
G. T. Chiou, D. E. Kile, and D. W. Rutherford.
Environmental Science and Technology ESTHAG, Vol. 25, No. 4, p 660-665, April 1991.

Descriptors: *Alkylbenzene sulfonates, *Linear alkyl sulfonates, *Oil, *Organic pollutants, *Path of pollutants, *Surfactants, Chlorinated aromatic compounds, DDT, Polychlorinated biphenyls, Solubility, Synergistic effects, Wastewater disposal.

Apparent water solubilities of DDT, pentachlorobiphenyl (PCB) and trichlorobenzene were determined at room temperature in aqueous solutions of commercial linear alkylbenzenesulfonate (LAS), oil-free (solvent-extracted) LAS and single-molecular 4-dodecyl-benzenesulfonate. The extent of solute solubility enhancement by commercial LAS is markedly greater than that by other ionic surfactants below the measured critical micelle concentration (CMC); above the CMC, the enhancement data with LAS are comparable with other surfactants as micelles. The small amount of neutral oils in commercial LAS (1.7%), comprising linear alkyl-benzenes (LABs) and bis(alkylphenyl) sulfones, contributes significantly to the enhanced solubility of DDT and PCB below the CMC; the effect is ascribed to formation of oil-surfactant emulsions. The oil-surfactant emulsion corresponds to 9-10% of the commercial LAS below the CMC. The data suggest that discharge of wastewater containing a significant level of oils and surface-active agents could lead to potential mobilization of organic pollutants and LABs in aquatic environments. (Author's abstract)
W91-11963

MEASUREMENT AND PREDICTION OF COPPER ION ACTIVITY IN LAKE ORTA, ITALY.
Istituto di Ricerca sulle Acque, Brugherio (Italy).
M. Camusso, G. Tartari, and A. Zirino.
Environmental Science and Technology ESTHAG, Vol. 25, No. 4, p 678-683, April 1991. 7 fig, 4 tab, 23 ref.

Descriptors: *Copper, *Heavy metals, *Italy, *Lake Orta, *Path of pollutants, Analytical methods, Hydrogen ion concentration, Ion-selective electrodes, Ions, Lake restoration.

A commercial copper-ion-selective electrode (ISE) mounted on a field conductivity, temperature, depth probe equipped with pH and oxygen sensors was used to measure a profile of copper ion (Cu(2+)) activity in Lake Orta, Italy. Lake Orta water contains approximately 32-34 micrograms/L Cu from anthropogenic sources. Below the mixed layer, Cu(2+) activity was directly related to the pH of the lake water. In the body of the hypolimnion, measurements of Cu(2+) activity were in good agreement with estimates of Cu(2+) activity obtained from total Cu concentrations. The pH dependence of the activity/concentration of free Cu(2+) was modeled with a simple ion association model of the lake water. The results of the model were verified by a potentiometric titration of a sample of lake water using Cu, pH and ammonia ISEs. The titration simulated a forthcoming chemical treatment now in progress. (Author's abstract)
W91-11965

APPLICATION OF A FOOD CHAIN MODEL TO POLYCHLORINATED BIPHENYL CONTAMINATION OF THE LOBSTER AND WINTER FLOUNDER FOOD CHAINS IN NEW BEDFORD HARBOR.
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
J. P. Connolly.
Environmental Science and Technology ESTHAG, Vol. 25, No. 4, p 760-770, April 1991. 13 fig, 1 tab, 42 ref.

Descriptors: *Flounders, *Food chains, *Lobsters, *Model studies, *Path of pollutants, *Polychlorinated biphenyls, Lipids, Marine pollution, Massachusetts, New Bedford Harbor Superfund Site, Sediment contamination.

As part of a Remedial Investigation/Feasibility Study for the New Bedford Harbor Superfund site a model of polychlorinated biphenyls (PCBs) in the lobster and winter flounder food chains was developed. This model successfully reproduces tri-, tetra-, penta-, and hexachlorobiphenyl concentrations observed at all levels of the food chain and across the two order of magnitude concentration gradient in the system. The model indicates that PCB concentrations in the flounder and, to a lesser extent, in the lobster are derived from the sediment. Dietary uptake exceeds uptake across the gill for all four homologues and becomes the dominant route at the higher chlorinated homologues. The assimilation efficiency of ingested PCB apparently declines from relatively high values for trichlorobiphenyl to relatively low values for hexachlorobiphenyl. Differences in observed lobster and flounder PCB concentrations appear to be due to differences in the importance of the benthic component of the food chains of these animals and differences in whole body lipid content. (Author's abstract)
W91-11967

PHYSICAL FACTORS INFLUENCING WINTER PRECIPITATION CHEMISTRY.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Atmospheric Physics Lab.
For primary bibliographic entry see Field 2B.
W91-11968

LOW-INTENSITY RADIOLYSIS STUDY OF FREE-RADICAL REACTIONS IN CLOUDWATER: H2O2 PRODUCTION AND DESTRUCTION.
Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
For primary bibliographic entry see Field 2B.
W91-11969

ON-SITE SEWAGE DISPOSAL--THE INFLUENCE OF SYSTEM DENSITY ON WATER QUALITY.
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W91-11970

MERCURY LEVELS IN THE COMPONENTS OF THE ENVIRONMENT AND DIETS.
Vyskumny Ustav Preventivneho Lekarstva, Bratislava (Czechoslovakia).
O. Palusova, M. Ursinyova, and J. Uhnak.
Science of the Total Environment STENDL, Vol. 101, No. 1/2, p 79-82, January 1991. 4 tab, 13 ref.

Descriptors: *Drinking water, *Dusts, *Foods, *Mercury, *Path of pollutants, *Public health, *Soil types, *Surface water, Czechoslovakia, Fish, Fruit crops, Poultry, Standards, Vegetable crops.

The levels of mercury in water, soil, plants, poultry and poultry products, fish, dustfall and total daily diet were measured for the purpose of estimating the average daily intakes of mercury in Czechoslovakia. The Hg values found in drinking water ranged from 0.00 to 0.30 micrograms/cubic dm and those in surface waters from 0.10 to 1.30 microg/cu dm. The median mercury content in dustfall was found to be 0.239 microg/g, or 0.704 microg/sq m/30 days. The median mercury values in fruits (3 microg/kg dry mass) were lower than in vegetables (12 to 21 microg/kg). Mercury levels in fish and fish products did not exceed 0.2 mg/kg. The mercury dose found in the total diet--14 micrograms per day, or 98 micrograms per week--is two-thirds lower than the Food and Agriculture Organization/World Health Organization weekly temporary tolerated dose standard of 300 micrograms Hg per person. The mercury levels found in all commodities analyzed are in agreement with the data given by other authors and do not exceed maximum permissible concentration values. (Feder-PTT)
W91-11974

URBAN PRECIPITATION CHEMISTRY: A REVIEW AND SYNTHESIS.
Illinois State Water Survey Div., Champaign. Atmospheric Chemistry Section.
For primary bibliographic entry see Field 2K.
W91-11987

STEM-II ACID DEPOSITION AND PHOTOCHEMICAL OXIDANT MODEL: II. A DIAGNOSTIC ANALYSIS OF MESOSCALE ACID DEPOSITION.
Iowa Univ., Iowa City. Dept. of Chemical and Biochemical Engineering.
S. G. Shim, and G. R. Carmichael.
Atmospheric Environment Part B: Urban Atmosphere AEBAE5, Vol. 25, No. 1, p 25-45, 1991. 19 fig, 2 tab, 13 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *MesoSTEM Model, *Model studies, *Path of pollutants, *STEM-II Model, Monitoring, Oxidation, Pennsylvania, Philadelphia, Photochemistry, Suburban areas.

The MesoSTEM model was used to analyze data obtained during the Mesoscale Acid Deposition Study which was designed to investigate acid deposition on the urban-suburban scale. Well defined frontal storms were sampled around the city of Philadelphia using a surface based network. The MesoSTEM model was developed to provide diagnostic analysis of these data. The model is a combination of the Mesoscale Atmospheric Simulation System (MASS) predictive mesoscale dynamic meteorological model and the STEM-II model, a three-dimensional Eulerian acid deposition model. The model predictions were shown to be qualitatively consistent with the observed wet chemistry. Both the observations and the model predictions showed only a slight difference in the wet deposition at the New Jersey and Pennsylvania monitoring locations. However, the emissions from Philadelphia were shown to impact acid deposition in the southwest corner of the modeling region. The model did, however, underpredict the wet deposition amounts, especially at the Pennsylvania sites. This underprediction is attributed to the underprediction of the forecasted precipitation rates. The results also indicate that the deposition on the mesoscale was strongly influenced by the transport of material into the region. (Author's abstract)
W91-11988

LAGRANGIAN BACKWARD TRAJECTORY MODEL AND ITS APPLICATION TO THE STUDY OF ACID RAIN IN THE EMEI MOUNTAINOUS DISTRICT.
Tongji Univ., Shanghai (China). Dept. of Environmental Engineering.
D. Jiang.
Atmospheric Environment Part B: Urban Atmosphere AEBAE5, Vol. 25, No. 1, p 59-65, 1991. 6 fig, 2 tab, 13 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *China, *Lagrangian model, *Model studies, *Mountains, *Path of pollutants, Clouds, Emei, Sichuan Basin, Sulfates, Sulfur dioxide.

A Lagrangian backward trajectory model was developed to study the variation of acidic pollutant concentrations in the Emei mountain area in China. The model is one level, with linear chemical transformations. However, simple cloud processes are included. The pollutants considered were SO2 and SO4(2-), both subcloud and incloud. Acidic pollutants originating within Emei were immediately obvious. The model was more important in determining the contribution of pollutants transported from outside Emei. It was determined that the distant sources contributing to acid rain in Emei were mainly restricted to the Sichuan Basin. The distant sources along the northeast line through Chengdu, rather than those along other directions such as directly from Chongqing or Yibing, etc., have the major effect on Emei acid rain. This model provides a simple method to study the variations of pollutant concentrations at a preselected site and the contribution apportionment of local and distant sources. However, a one-layer model cannot account for the effects of the inhomogeneity of meteorological conditions, which is the main feature of frontal systems. In addition, the updraft velocity at cloud base should be varying in space and time. (White-Reimer-PTT)
W91-11989

PROPANIL: TOXICOLOGICAL CHARACTERISTICS, METABOLISM, AND BIODEGRADATION POTENTIAL IN SOIL.
National Center for Toxicological Research, Jefferson, AR.
J. V. Pothuluri, J. A. Hinson, and C. E. Cerniglia.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 330-347, 1991. 7 fig, 4 tab, 172 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Herbicides, *Path of pollutants, *Propanil, *Rice, *Soil contamination, *Toxicity, *Toxicology, *Water pollution effects, Clays, Fish farming, Genotoxicity, Loam, Metabolism, Sand, Teratogenicity.

Propanil (3',4'-dichloropropionanilide (DCPA)) is a biologically active pollutant. Propanil is extensively used around the world for control of weeds in rice production. Although propanil by itself is of low toxicity, the highly toxic impurities 3,3',4,4'-tetrachloroazobenzene (TCAB) and 3,3',4,4'-tetrachloroazoxybenzene (TCAOB) from the manufacture of 3,4-dichloroaniline (DCA) often contaminate the 3,4-DCA-derived herbicide propanil. These compounds are approximately isoteric to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), and acting at the Ah receptor, are toxic by mechanisms similar to those of TCDD. Both TCAB and TCAOB are cytotoxic, embryolethal, and teratogenic, and hence are classified as possible human genotoxins. In soil, biodegradation of propanil liberates DCA, which is converted by microbial peroxidases to TCAB and other azo products. The TCAB and TCAOB may accumulate in rice-growing soils, and leach into groundwater. Propanil has been found to be resistant to hydrolysis at pH 7 and 9. This chemical is mobile to very mobile in soils such as sand, sandy loam, silt loam, clay loam, and clay, as determined by leaching studies. However, groundwater has not been monitored for propanil residues. Residues of propanil found in rice flood water suggest that propanil application to rice may result in residues being accumulated in fish and irrigation water, due to drainage of rice flood water into fish farming waters. (White-Reimer-PTT)
W91-11994

NITROGEN LEACHING LOSSES FROM IRRIGATED ORCHARDGRASS ON SANDY SOILS.
Nebraska Univ.-Lincoln. Dept. of Biological Systems Engineering.
D. G. Watts, G. W. Hergert, and J. T. Nichols.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 355-362, 1991. 8 fig, 2 tab, 15 ref.

Descriptors: *Groundwater contamination, *Leaching, *Nitrogen, *Nonpoint pollution sources, *Nutrient transport, *Orchardgrass, *Pasture management, *Path of pollutants, *Sandy soils, *Water pollution sources, Crops, Forages, Grasslands, Irrigation effects, Irrigation practices, Nebraska, Nitrates, Pastures.

Irrigated pasture may provide an alternative forage source for livestock producers in Nebraska's Sandhills. As with any heavily fertilized crop, there is significant potential for groundwater contamination by nitrate nitrogen (NO3-N) leached from the crop root zone. A 3-yr experiment was conducted an West Central Nebraska to evaluate water and nitrate (NO3-) leaching losses from irrigated orchardgrass (Dactylis glomerata L.) seeded on a Valentine fine sand (Typic Ustipsamments). Three irrigation levels (slight deficit, slight excess, and excess) and four N amounts (0,112, 224, and 336 kg/ha) were applied. Deep percolation and NO3(-) leaching were measured with Duke-Haise trough-type extractors. All irrigation treatments had more deep percolation than expected, as the crop coefficient used for irrigation scheduling proved to be too large. The deficit irrigation treatment served as a 'close management' treatment since percolation was minimal and yield was not reduced by water stress. During the first 2 yr of operation, in-season percolation losses averaged 7, 28, and 47 cm/yr for low, medium, and high irrigation levels, respectively. Total in-season NO3-N leaching loss for the same period ranged from 6 to 228 kg/ha, depending on N and irrigation amount. Winter and early spring N leaching losses, as estimated by soil sampling, were a significant part of total N loss. Under reduced in-season drainage and an N rate commensurate with 80 to 85% of maximum production, a minimum annual N leaching loss of 35 kg/ha can be expected. Greater losses are probable under average water and N applications and average management skills. (Author's abstract)
W91-11995

LYSIMETER STUDY OF NITROGEN FERTILIZER AND IRRIGATION RATES ON QUALITY OF RECHARGE WATER AND CORN YIELD.
North Dakota State Univ., Fargo. Dept. of Soil Science.
L. Prunty, and B. R. Montgomery.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 373-380, 1991. 3 fig, 4 tab, 22 ref. Dept. of Interior Bureau of Reclamation Cooperative Agreement 7-FC-60-00350.

Descriptors: *Corn, *Crop yield, *Fertilizers, *Groundwater pollution, *Groundwater quality, *Nitrates, *Nonpoint pollution sources, *Nutrient transport, *Path of pollutants, *Water pollution sources, Drainage water, Economic aspects, Groundwater recharge, Irrigation practices, Irrigation water, Loam, Lysimeters, Nitrogen, North Dakota, Sand.

Accrual of NO3-N to groundwater as a result of agricultural practices is a focus of environmental concern. This inquiry was conducted to quantify precisely in a replicated experiment the rate of N loading to groundwater resulting from inputs of N and irrigation water to corn (Zea mays L.). Input levels were designed to balance potential for high production with minimum loading of NO3-N to groundwater. Four large (2.4 by 2.4 m and 2.3 m deep) drainage lysimeters with reconstructed Hecla loamy fine sand (Aquic Habloborolls) were employed in this southeast North Dakota study. Grain yields at N fertilizer rates of 95 and 145 kg/ha were 10.3 and 11.3 Mg/ha, respectively. Differences in yield due to irrigation and irrigation by N interaction were nonsignificant. There was no residual effect of N fertilizer on yield. The higher irrigation rate caused increases in drainage of water within about 30 d. The higher rate of N fertilizer, however, was not reflected by increased concentration of NO3-N in the drainage water until 325 d after application. The increased concentrations for this period were 8.6 and 12.3 mg/L for the low and high N rates, respectively. For this soil and climate, irrigation and N management can be tailored to produce NO3-N concentrations below 10 mg/L with continuous corn. However, the 5:1 economic return produced by 50 kg/ha of incremental N fertilizer means that producers are unlikely to adopt the needed practices without incentives. (Author's abstract)
W91-11996

CHEMICAL FRACTIONATION AND PLANT UPTAKE OF HEAVY METALS IN SOILS AMENDED WITH CO-COMPOSTED SEWAGE SLUDGE.
Delaware Univ., Newark. Dept. of Plant Science.
J. T. Sims, and J. S. Kline.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 387-395, 1991. 4 fig, 6 tab, 36 ref.

Descriptors: *Bioaccumulation, *Composting, *Heavy metals, *Land disposal, *Path of pollutants, *Sludge utilization, *Soil amendments, *Soil chemistry, Cadmium, Chromium, Copper, Correlation analysis, Crops, Lead, Liming, Nickel, Regression analysis, Separation techniques, Soil-water-plant relationships, Soybeans, Wheat, Zinc.

A sequential extraction method (KNO3, NaOH, Na2-EDTA, HNO3) was used to determine the soil fractions and plant availability of Cd, Cr, Cu, Ni, Pb, and Zn in three Atlantic coastal plain soils amended with four rates of co-composted sewage sludge (CCSS:0, 11, 22, and 44 Mg/ha), limed to four pH values (pH 5.3-7.2) and used to grow wheat (Triticum aestivum L.) and soybean (Glycine max L.) under greenhouse conditions. The average (across soils) increases in total soil Cd, Cr, Cu, Ni, Pb, and Zn, at the highest rate of CCSS were 0.1, 2, 7, 5, 14, and 14 mg/L, respectively. Distribution of all metals except Cd, differed in CCSS-amended soils, with greater percentages found in the NaOH and EDTA fractions and less in the HNO3 form than in unamended soils. The more labile fractions (KNO3, H2O) of Cu, Ni, Pb, and Zn, but not Cd and Cr, increased slightly (<1 mg/kg) when CCSS was added. Liming usually resulted in minor (<5%) changes in the distribution of Cd, Cr, Ne, and Pb among soil fractions. The CCSS had little effect on concentrations of Cd, Cr, or Pb in either crop, but consistently increased Cu, Ni, and Zn in vegetative tissues of wheat and soybean, and Ni and Zn in soybean grain. Liming decreased Mn and Zn in wheat and soybean, and Ni in soybean grain, but rarely affected plant Cd, Cr, Cu, or Pb. With the exception of Zn, consistent correlations between total soil metal content or individual metal fractions and plant metal concentrations or uptake were not observed. However, significant multiple regression models between soil metal fractions and pH and metal concentrations were obtained for Ni, Cu, and Zn with all three soils. (Author's abstract)
W91-11997

BASEFLOW AND STORMFLOW TRANSPORT OF NUTRIENTS FROM MIXED AGRICULTURAL WATERSHEDS.
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens, W. M. Edwards, and R. W. Keuren.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 407-414, 1991. 4 fig, 5 tab, 21 ref.

Descriptors: *Agricultural watersheds, *Base flow, *Nitrogen, *Nonpoint pollution sources, *Nutrient transport, *Ohio, *Path of pollutants, *Runoff, *Storm runoff, *Water pollution sources, Cropland, Fertilization, Forest watersheds, Land management, Land use, Pastures.

Relative water and nutrient transports via storm runoff were compared with amounts removed in continuous baseflow, and the influence of different management practices on such transport were evaluated. Baseflow and storm runoff from four watersheds in east-central Ohio with different land use practices were measured, sampled, and analyzed for these comparisons. In two watersheds, 123 and 32.1 ha in size containing woodland, pasture, and row crops, the majority of N moved from the watersheds in the storm runoff; however, 25 to 50% of the N transport was via baseflow. Using 10 yr averages, 5.0 and 2.8 kg/ha of mineral N were annually transported from the 123-ha watershed via 242 and 196 mm of storm runoff and baseflow, respectively. Mineral N transport from a 28.8-ha poor practice pasture watershed and from a 17.7-ha wooded watershed was less than above, but the proportions in storm runoff and baseflow were similar. Although stormflow was the larger transport pathway for nutrients leaving a watershed, a sizable portion of the nutrients can be carried with the baseflow. This comparison of watersheds in the unglaciated area indicates that there is a negligible difference in the quality of water leaving an unfertilized wooded area or unfertilized pasture or a watershed that receives fertilization on 55% of its area. (Author's abstract)
W91-12000

TRANSPORT AND PREDICTION OF SULFATE IN AGRICULTURAL RUNOFF.
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
A. N. Sharpley, S. J. Smith, O. R. Jones, W. A. Berg, and G. A. Coleman.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 415-420, 1991. 3 fig, 3 tab, 45 ref.

Descriptors: *Acid rain effects, *Agricultural runoff, *Agricultural watersheds, *Cropland, *Nutrient transport, *Path of pollutants, *Sulfates, *Water pollution sources, Acidification, Hydrogen ion concentration, Land management, Mathematical equations, Projections.

The measurement and simulation of sulfate-S (SO4-S) mobility in agricultural watersheds is necessary to evaluate the effect of management practices on associated crop S deficiencies, enhanced leaching loss of nutrient cations, and acidification of percolation waters. The concentrations and amounts of SO4-S in runoff from six grassed and 13 cropped watersheds in the Southern Plains were measured over a 4-yr period. Sulfate-S transport in runoff was predicted using an equation describing the kinetics of SO4-S desorption from soil and compared with measured values. No SO4-S was added to any of the watersheds directly as S fertilizer or indirectly in N or P fertilizer material. No difference (at 5% level) in SO4-S concentration in runoff from grassed (mean annual value of 12.6 mg/L) and cropped (mean annual value of 11.0 mg/L) watersheds was observed. Differences in amounts (0.2-18.9 kg/ha/yr) were a function of runoff volume as influenced by land management. A general trend of increasing SO4-S concentration in runoff with decreasing pH was observed, which may be a function of S dry deposition and soil and crop conditions. Measured and predicted SO4-S concentrations in runoff for individual events were not significantly different (at 5% level), with an average predictive standard error of 1.6 mg/L for all watersheds, representing 17% of the measured concentration. The equation may provide a predictive tool in agronomic and environmental studies of SO4-S movement in agricultural watersheds. (Author's abstract)
W91-12001

FATE OF VOLATILE AND SEMIVOLATILE ORGANIC CHEMICALS IN SOILS: ABIOTIC VERSUS BIOTIC LOSSES.
Tennessee Univ., Knoxville.
T. A. Anderson, J. J. Beauchamp, and B. T. Walton.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 420-424, 1991. 4 tab, 25 ref. DOE contract DE-AC05-84OR21400 and USEPA Interagency Agreement DW89931473-01-0.

Descriptors: *Fate of pollutants, *Organic chemicals, *Path of pollutants, *Soil contamination, *Volatile organic compounds, *Volatilization, Adsorption, Analytical methods, Biodegradation, Loam, Mass balance, Sample preservation.

Disappearance of 15 volatile and semivolatile organic compounds was determined in a mixture added to two different soil types, a Captina silt loam (Typic Fragiudult) and McLaurin sandy loam (Typic Paleudults), using experimental procedures to distinguish abiotic losses from biological degradation over a 7-d period. Losses due to volatilization were quantified and mass balances were calculated for each compound. The compounds (methyl ethyl ketone; tetrahydrofuran; chlorobenzene; benzene; chloroform; carbon tetrachloride; p-xylene; 1,2-dichlorobenzene; cis-1,4-dichloro-2-butene; 1,2,3-trichloropropane; 2-chloronaphthalene; ethylene dibromide; hexachlorobenzene; nitrobenzene; and toluene) were applied to the soil in a mixture such that the concentration of each chemical was 100 mg/kg soil (dry st.). The headspace of the soil samples and matched sterile (autoclaved) controls, which were incubated in the dark at 20 C in stoppered jars fitted with charcoal traps, was flushed daily to maintain aerobic conditions and to trap vapors. Apparent half-lives for the 15 organic compounds ranged from < 2 to 11.3 d and showed good agreement with published values in the few instances where they were available. Rapid disappearance due to abiotic factors was observed for all chemicals during the 7-d period. Although short-term spike and recovery analyses yielded consistently reproducible recovery for all compounds, careful attempts to account for all losses, including the use of 14C-toluene, were unsuccessful. Nonreversible sorption and preanalysis storage conditions were considered as contributors to this inability to achieve a mass balance. These results indicate the importance of positive accounting for all test compounds and degradation products at the conclusion of studies involving volatile and semivolatile compounds. (Author's abstract)
W91-12002

MODELING THE INFLUENCE OF SORPTION AND TRANSFORMATION ON PESTICIDE LEACHING AND PERSISTENCE.
Winand Staring Centre for Integrated Land, Soil and Water Research, Wageningen (Netherlands).
J. J. T. I. Boesten, and A. M. A. van der Linden.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 425-435, 1991. 7 fig, 66 ref.

Descriptors: *Groundwater pollution, *Leaching, *Model studies, *Path of pollutants, *Pesticide kinetics, *Pesticide residues, *Pesticides, *Sorption, Agricultural chemicals, Corn, Evapotranspiration, Rainfall, Sandy soils, Seasonal variation, Temperate zone, Temperature.

Pesticide leaching to groundwater at 1 m depth and pesticide persistence in the plow layer were calculated with a mathematical model for a sandy soil continuously cropped with maize (Zea mays L.) and exposed to weather conditions in a temperate climate. The pesticide was applied in spring. In the model, water flow was described by Darcy's law and water uptake by the crop was included.

Daily averages of meteorological conditions (rainfall, evapotranspiration, soil temperature) were used as input. The model assumes first-order transformation, equilibrium sorption (Freundlich equation), and passive plant uptake. Pesticide leaching and persistence were calculated as a function of pesticide sorption (characterized by the organic-matter/water distribution coefficient, Kom) and of transformation rate. It was found that pesticide leaching is very sensitive to both Kom and the transformation rate; changing Kom or the transformation rate by a factor of 2, changes the fraction of the dose leached typically by about a factor of 10. Pesticide persistence in the plow layer was found to be sensitive to Kom at low transformation rates and sensitive to the transformation rate at high Kom values. Additional calculations showed that autumn application results in much higher leaching of nonsorbing pesticides with short half-lives than spring application (difference of two orders of magnitude). (Author's abstract)
W91-12003

PHOSPHORUS LOADS FROM SELECTED WATERSHEDS IN THE DRAINAGE AREA OF THE NORTHERN ADRIATIC SEA.
Milan Univ. (Italy). Inst. of Agricultural Entomology.
M. Vighi, S. Soprani, P. Puzzarini, and G. Menghi.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 439-444, 1991. 3 fig, 7 tab, 22 ref.

Descriptors: *Adriatic Sea, *Agricultural runoff, *Agricultural watersheds, *Eutrophication, *Italy, *Nonpoint pollution sources, *Nutrient transport, *Path of pollutants, *Phosphorus, *Pollution load, *Water pollution sources, Erosion, Fertilizers, Forest watersheds, Po River Basin.

The Po Valley is one of the most productive agricultural areas in Europe and P losses from fertilizers are often accused of being among the main factors responsible for eutrophication of the Northern Adriatic Sea. To quantify nonpoint phosphorus loads in this area, 15 small watersheds were studied. Thirteen watersheds were in the intensive agricultural area near the coast and two watersheds were in the forested mountains. Land use in the watersheds was carefully examined and P loads from various sources were theoretically evaluated and experimentally measured. The results indicate fertilization does not increase the losses of P through leaching from the coastal soils, where the measured releases were in the range 0.03 to 0.21 kg P/ha per year with a mean value of about 0.1 kg P/ha per year. There is, however, a greater loss of P through soil erosion from the mountain watersheds (0.6 kg/ha per year). It can be concluded that the control of point sources must take priority over nonpoint sources in efforts to reduce accelerated eutrophication of the Northern Adriatic Sea. (Author's abstract)
W91-12004

REDUCTION OF DISSOLVED OXYGEN CONCENTRATION IN WISCONSIN STREAMS DURING SUMMER RUNOFF.
Geological Survey, Madison, WI.
D. J. Graczyk, and W. C. Sonzogni.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 445-451, 1991. 7 fig, 2 tab, 31 ref.

Descriptors: *Agricultural runoff, *Dissolved oxygen, *Nonpoint pollution sources, *Streamflow, *Water pollution effects, *Water pollution sources, *Wisconsin, Fishkill, Photosynthesis, Rural areas, Seasonal variation, Temperature.

It is commonly believed that runoff from heavy rainfall is not detrimental to the O content of rural streams free from industrial and municipal discharges. However, evidence is presented of low dissolved O (DO) concentrations during high flows (caused by agricultural runoff during summer rainstorms) in southern Wisconsin streams. Continuous monitoring of streams with in situ oxygen meters indicated a rapid decrease in dissolved oxygen with a rise in the hydrograph. The cause of the oxygen reduction may be due to one or more factors such as: (1) inflow of large volumes of runoff with low DO concentrations; (2) the influx or resuspension of O demanding materials as a result of the storm water input; (3) decreased O solubility caused by increased water temperature; and (4) possible reduced photosynthetic productivity. Loss of DO is important because it appears to be associated with fish kills and declining sport fish populations in streams in the regions. (Author's abstract)
W91-12005

CHEMICAL COMPOSITION OF OCHREOUS PRECIPITATES FROM OHIO COAL MINE DRAINAGE.
Ohio State Univ., Columbus. Dept. of Agronomy.
R. L. Winland, S. J. Traina, and J. M. Bigham.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 452-460, 1991. 8 fig, 7 tab, 33 ref.

Descriptors: *Acid mine water, *Chemical properties, *Coal mining effects, *Heavy metals, *Iron oxides, *Mine drainage, *Ohio, Adsorption, Aluminum, Hydrogen ion concentration, Iron, Organic matter, Precipitation, Silica, Solubility, Sulfates.

Ochreous precipitates and associated solutions were collected from waters draining abandoned coal works at 28 locations in eastern Ohio. Major and trace element contents of the precipitates were determined, and comparisons were make with source solutions to evaluate the effects of pH, organic C, and ionic strength on solid-phase composition and trace metal distribution. The pH and calculated ionic strength of the effluents ranged from 2.6 to 7.8 and 6 to 106 mmol/L, respectively. Associated precipitates consisted primarily of poorly crystallized oxides and oxyhydroxides of Fe with jarosite occurring as a major constituent of only one specimen. Mean Fe, SO4, Al, and Si contents of the precipitates were 8.7, 1.34, 1.11, and 0.25 mol/kg, respectively. Silicon content increased with increasing pH of the source solution suggesting pH-dependent adsorption. In contrast, SO4 and Al appeared to be influenced both by precipitation and adsorption reactions. Partition coefficients for As, B, Ba, Co, Cu, Cr, Mn, P, and Zn showed a preferential accumulation of all elements by the solid phase with increasing pH and decreasing ionic strength of the drainage waters. Copper appeared to be strongly associated with organic matter, and a weaker but positive relationship was also observed with Co and Zn. No effects of pH, ionic strength, or organic C were observed for any other trace elements. Solubility equilibrium calculations suggested that the solid phase concentrations of Co, Cr, Cu, Mn, Zn, and As were primarily controlled by adsorption and/or coprecipitation phenomena whereas Ba and P activities in solution exceeded the solubilities of barite and strengite, respectively. (Author's abstract)
W91-12006

HEAVY METAL EXTRACTABILITY IN LONG-TERM SEWAGE SLUDGE AND METAL SALT-AMENDED SOILS.
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
P. F. Bell, B. R. James, and R. L. Chaney.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 481-486, 1991. 2 fig, 2 tab, 29 ref.

Descriptors: *Bioavailability, *Heavy metals, *Leaching, *Path of pollutants, *Sludge disposal, *Soil amendments, Agriculture, Cadmium, Iron, Manganese, Soil chemistry, Soil-plant relationships, Zinc.

Heavy metals applied to agricultural soils as soluble salts are usually considered more plant available in the short-term than equivalent amounts of metals applied to soil in sewage sludge. Slow soil chemical processes over several years, however, may change the forms, extractability, and bioavailability of metals. To determine the long-term changes in forms of Cd added to a soil, Cd and other heavy metals were extracted with several solutions from a Christiana fine sandy loam (Typic Paleudult: clayey, kaolinitic, mesic) Ap horizon 8 or 9 yr after application of sewage sludge or CdCl2. Cadmium was applied at the rate of 21 kg/ha either as a component of sewage sludge or as CdCl2 in 1978 and 1979, respectively. In 1987 the distribution of Cd and other metals among soil fractions was operationally defined. The percentages of total soil Zn, Mn, and Fe extracted by DTPA and CA(NO3)2 from the sludge or salt-amended soils were much less (<4%) than the percentages for Cd (47-60%), indicating greater potential mobility for Cd than for the other metals, regardless of the form of Cd added originally. A larger percentage of total soil Cd was extracted with the paracrystalline iron oxide fraction of the sludge-amended soil (35%) than in the salt amended soil (24%). this greater apparent Cd association with Fe oxides in the sludge-amended soil may have been due to the greater quantity of paracrystalline Fe oxides in that soil (843 vs. 616 mg Fe/kg for the sludge and salt-amended soils, respectively). Compared to the sludge-amended soil, the salt-amended soil had a higher percentage of Cd in the soluble and exchangeable fractions (60 vs. 47% and nearly equal percentages in the residual fraction (15%), suggesting, at the same total soil Cd concentration, plant-available Cd would be greater from the salt-amended soil. The sludge addition apparently enhanced retention of Cd in an iron oxide pool, relative to the soluble and exchangeable forms. (Author's abstract)
W91-12007

TRACE ELEMENT CONTAMINATION OF SOILS IN THE INDIANA DUNES.
Norges Landbrukshoegskole, Aas. Dept. of Soil Sciences.
K. B. Esser, P. A. Helmke, and J. G. Bockheim.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 492-496, 1991. 4 fig, 2 tab, 19 ref.

Descriptors: *Air pollution, *Dunes, *Heavy metals, *Indiana, *Path of pollutants, *Soil contamination, *Trace elements, Aerosols, Humus, Soil chemistry, Soil profiles.

Potential soil contamination by aerosol fallout and rainout and subsequent surface accumulation of trace elements in four soils in the Indiana Dunes have been evaluated based on chemical analyses using x-ray fluorescence and neutron activation analysis and data from the literature. Among the studied elements, Se, Sb, Zn, and As show highest concentrations in aerosols relative to the soils. The surface accumulation of trace elements in the soil is a function of the proximity to the pollution sources, vegetation, and the organic matter content of the surface horizon. In the studied soils, presence of humus is essential for the retention of trace elements added by aerosols. Enrichment in the Ah horizon compared to the B horizon is, in decreasing order, evident for Mn, Sb, Zn, As, Cs, Se, Cr, Fe, and Co. Contaminant Mn, Sb, As, Se, and possibly Zn have migrated into the E horizon. Bioaccumulation of trace elements has been insignificant in view of apparent input of the elements by deposition, possibly with the exception of Se. (Author's abstract)
W91-12009

FATE OF LEAD FROM DUCK SHOOTING AND ROAD RUNOFF IN THREE WESTERN AUSTRALIAN WETLANDS.
Murdoch Univ. (Western Australia). School of Biological and Environmental Sciences.
M. Lund, J. Davis, and F. Murray..
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 42, No. 2, p 139-149, 1991. 3 fig, 1 tab, 43 ref.

Descriptors: *Australia, *Highways, *Lead, *Path of pollutants, *Recreation, *Runoff, *Water pollution sources, *Wetlands, Air pollution, Aquatic plants, Bioaccumulation, Lake Monger, Lake Wannamal, Macroinvertebrates, Thomsons Lake.

This investigation examined whether lead shot from duck shooting was acting as a source of lead in an alkaline wetland ecosystem typical of popular duck shooting areas in Western Australia. A polluted urban wetland and a pristine wetland were also studied for comparison. Lake Wannamal receives an estimated 82 kg of lead shot/yr from duck shooting and no lead from any other known source. Lake Monger was estimated to receive 138

kg of lead/yr from road runoff, leachate from a sanitary landfill site, and lead from aerosols. Thomsons Lake has no known source of lead from human activities. Lead concentrations in sediments did not differ significantly between Lake Wannamal and Thomsons Lake and apparently represent natural background levels. Lake Monger sediments were contaminated (192 +/-82 microgm Pb/gm dry weight); the main source appeared to be runoff from a nearby freeway. Lead concentrations in Baumea articulata Blake, Typha orientalis Presl and Schoenoplectus validus Love were generally low; concentrations in the roots were higher than those in the leaves, suggesting that lead is poorly translocated. Lead concentrations in submerged macrophytes and in sediments were similar, which may be attributable to periphyton on the plants binding lead in seston resuspended by water turbulence. The cyanobacterium Microcystis sp. accumulated lead to low concentrations, believed to be from soluble lead in the water column. Macroinvertebrates accumulated lead to low concentrations, but no evidence was found of biomagnification. Lead concentrations were only slightly higher in macroinvertebrates in Lake Monger than in macroinvertebrates in the other lakes, indicating that lead uptake was poor even in a contaminated lake. (Author's abstract)
W91-12022

ACIDIFICATION-RELATED CHANGES IN THE BIOGEOCHEMISTRY AND ECOTOXICOLOGY OF MERCURY, CADMIUM, LEAD AND ALUMINUM: OVERVIEW.
Canadian Wildlife Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W91-12027

MERCURY METHYLATION IN AQUATIC SYSTEMS AFFECTED BY ACID DEPOSITION.
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
C. C. Gilmour, and E. A. Henry.
Environmental Pollution ENPOEK, Vol. 71, No. 2/4, p 131-169, 1991. 1 fig, 5 tab, 127 ref. EPA Grant CR-812699.

Descriptors: *Acid rain, *Acid rain effects, *Aquatic environment, *Ecosystems, *Literature review, *Mercury, *Methylation, *Path of pollutants, *Water pollution effects, Acidification, Aquatic bacteria, Bacteria, Biogeochemistry, Hydrogen ion concentration, Sulfates, Sulfur bacteria.

Recently, it has been noted that fish in acidified lakes may contain elevated levels of mercury. While there is correlation among lakes between depressed pH and high Hg concentrations in fish, the cause of this problem is unknown. A number of hypotheses have been advanced in explanation, including increased Hg deposition, changes in Hg mobility due to acidification, pH dependent changes in Hg uptake by biota, and alterations in population size and/or structure which result in increased bioaccumulation in fish. Because fish accumulate Hg mainly in an organic form, methylmercury, changes in the biogeochemical cycling of this compound might account for elevated bioaccumulation. Mercury methylation is predominantly a microbial process which occurs in situ in lakes. This review focuses on microbiological and biogeochemical changes that may lead to increased levels of methylmercury in fresh waters impacted by acid deposition. In particular, focus is placed on the hypothesis that sulfate-reducing bacteria are important mediators of metal methylation in aquatic systems and, moreover, that sulfate-deposition may stimulate methylmercury production by enhancing the activity of sulfate-reducing bacteria in sediments. (Author's abstract)
W91-12029

ACIDIFICATION, METALS AND MACROPHYTES.
Queen's Univ., Kingston (Ontario). Dept. of Biology.
A. Crowder.
Environmental Pollution ENPOEK, Vol. 71, No. 2/4, p 171-203, 1991. 2 fig, 139 ref.

Descriptors: *Acid rain, *Acid rain effects, *Acidification, *Heavy metals, *Literature review, *Macrophytes, *Path of pollutants, Air pollution, Aluminum, Aquatic plants, Bioaccumulation, Cadmium, Hydrogen ion concentration, Lead, Lethal limit, Mercury, Sediment contamination, Toxicity.

Plant-specific and metal-specific uptakes of Al, Cd, Pb and Hg are reviewed, using examples from bryophytes, lichens, wetland plants, woody plants and crop plants. Ranges of plant metal concentration, toxic thresholds and effects, and effects of metal on biomass are derived from the literature. Relationships of metal in plants to metals in sediment, soil, water and air are discussed. Plant Al is negatively correlated with pH of water in lakes and with soil pH. Cadmium in crop plants is negatively related to soil pH. Lead in submergents is related negatively to sediment pH at 4.5 to 6. Little information on plant Hg was available. Factors affecting plant uptake include soil or sediment organic content, carbon exchange capacity, oxide and carbonate content, and conductivity as well as total metal content. (Author's abstract)
W91-12030

EFFECT OF ACIDIFICATION ON THE ACCUMULATION AND TOXICITY OF METALS TO FRESHWATER INVERTEBRATES.
B.A.R. Environmental, Toronto (Ontario).
For primary bibliographic entry see Field 5C.
W91-12031

METAL BIOAVAILABILITY AND TOXICITY TO FISH IN LOW-ALKALINITY LAKES: A CRITICAL REVIEW.
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
For primary bibliographic entry see Field 5C.
W91-12032

RADIONUCLIDES IN THE ENVIRONMENT.
Section of Energy, Div. of Water and Pollution Prevention, Dept. of Environment, 14, Boulevard du General Leclerc, 92524 Neuilly-sur-Seine Cedex, France.
P. Diffre.
Journal of Environmental Pathology, Toxicology and Oncology JEPOEC, Vol. 10, No. 6, p 276-280, November/December 1991. 18 ref.

Descriptors: *Environmental chemistry, *Pollutant identification, *Radionuclides, Cesium radioisotopes, Iodine radioisotopes, Krypton, Nuclear powerplants, Radioecology, Radium, Radon, Rain, Rivers, Strontium, Tritium, Uranium, Water quality.

The most common radionuclides in the atmosphere are: 222-Rn of mineral origin; tritium of cosmic origin and that produced by nuclear explosions and nuclear powerplants; 129-I, 90-Sr, 137-Ce, and 85-Kr resulting from nuclear tests or reprocessing of combustible materials. The radionuclides in rain water, underground water, river water, and seawater are somewhat different. In rain water, the most frequent radionuclides are Be of cosmogenic origin, 14-C, 3-H, 90-Sr, and 137-Ce from natural and artificial sources; the total normal beta radioactivity is on the order of 1 Bq/L. In underground water, 238-U and its daughter products predominate. For 226-Ra, an amount on the order of 0.1 Bq/L can be considered normal. For 222-Ra, the minimal concentrations are on the order of 10 Bq/L, but they can be greatly elevated at the sources of thermal springs; in certain cases, the personnel in thermal baths risk significant exposure. In river water, the radioactivity is generally weak, being primarily from 40-K; the fallout from nuclear tests is still detectable, as are traces of fission or activation products downstream from nuclear facilities; in France, the total beta radioactivity in the water is generally < 0.2 Bq/L. In sea water, the beta radioactivity, primarily from 40-K, is on the order of 10 Bq/L. (Author's abstract)
W91-12035

DIOXIN BIOACCUMULATION: KEY TO A SOUND RISK ASSESSMENT METHODOLOGY.
Rifkin and Associates, Inc., Columbia, MD.
E. Rifkin, and J. LaKind.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 33, No. 1, p 103-112, May 1991. 2 fig, 1 tab, 27 ref.

Descriptors: *Bioaccumulation, *Dioxins, *Model studies, *Path of pollutants, *Public health, *Risk assessment, *Toxicology, *Water quality management, Fate of pollutants, Fish, Standards, Water pollution control.

Human exposure to many pollutants occurs primarily through the ingestion of contaminated fish. In order to protect human health, regulatory agencies set limits on the levels of pollutants entering water bodies from point sources, thereby limiting the amount of pollutants that may be accumulated by fish. The limits, in the form of water quality criteria, are designed to correlate the concentration of a pollutant in a water body (and therefore the concentration accumulated by a fish) to the risks to humans. This type of model provides a reasonable way of controlling pollutants from point sources if the assumptions used in the model are realistic. However, the risk assessment formula currently used for developing water quality criteria only considers those pollutants in the water column available to fish through bioconcentration across the gills (freely dissolved pollutants). For strongly hydrophobic pollutants like dioxin, an extremely small fraction of the total amount is freely dissolved; most dioxin is sorbed to organic matter and is ingested by fish. A new model for developing criteria is presented that takes into account the environmental fate of dioxin (predominantly in the sorbed state in the environment) and that fish accumulate dioxin by ingestion, rather than bioconcentration. (Author's abstract)
W91-12037

PARTICULATE METALS IN FIVE MAJOR NORTH SEA ESTUARIES.
Plymouth Polytechnic (England). Inst. of Marine Studies.
A. Turner, G. E. Millward, and A. W. Morris.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No.4, p 325-346, April 1991. 6 fig, 8 tab, 96 ref. NERC Contract No. F3CR05-B13-01-01.

Descriptors: *Estuarine environment, *Marine pollution, *Metals, *North Sea, *Particulate matter, *Path of pollutants, *Suspended sediments, Carbon, Chemical composition, Chromium, Cobalt, Copper, Estuaries, Iron, Lead, Manganese, Mixing, Nickel, Prediction, Salinity, Sediment transport, Trace metals, Water quality monitoring, Zinc.

Suspended sediment samples collected from the North Sea and during axial surveys of five major North Sea estuaries (Humber, Thames, Scheldt, Weser, Elbe) were analyzed for leachable metals, specific surface area, and carbon. Particulate trace metal (Co, Cr, Cu, Ni, Pb, Zn) concentrations were similar in each estuary and estimates of fluxes to the North Sea based on an empirically derived prediction equation therefore reflected catchment size. Concentrations generally decreased seawards as a result of mixing of riverborne sediment of high metal concentration with material of marine origin of relatively low metal concentration, although in the Humber, substantial anthropogenic inputs at high salinities were responsible for more ambiguous distributions. In contrast, profiles and concentrations of Fe and Mn, implicated as being important to particle surface and compositional properties, exhibited significant yet explicable interestuarine variability (e.g., Humber during winter: Fe=12.0 mg/g, Mn=0.99 mg/g; Elbe during summer: Fe=6.6 mg/g, Mn=3.08 mg/g). Comparable data such as these serve as valuable baselines for any future international long-term water quality monitoring program of European estuaries. (Author's abstract)
W91-12044

RADIONUCLIDE DISTRIBUTIONS IN SEAWATER AROUND THE SELLAFIELD PIPELINE.

AEA Technology, Harwell (England). Energy and Environment.
M. I. Walker, and W. A. McKay.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No.4, p 385-393, April 1991. 3 fig, 4 tab, 13 ref.

Descriptors: *Americium radioisotopes, *Irish Sea, *Path of pollutants, *Pipelines, *Plutonium radioisotopes, *Radioactive wastes, *Radioisotopes, *Seawater, *Sellafield Pipeline, *Water pollution prevention, Actinide elements, Adsorption, Mineralogy, Radiochemical analysis, Spectrometry, Surveys, Tides.

A detailed survey of plutonium and americium in seawater within a 10-km radius of the Sellafield pipeline in the Irish Sea was undertaken in September 1988. This is an area where steep gradients in Pu and Am filtered seawater concentrations have been observed. However, previous studies were not detailed, and mainly provided information on radionuclides in filtered seawater. Sampling was carried out on September 20 between 4 and 9 h after high water, during a southward-flowing tide. This was to avoid sampling near the pipeline while Sellafield was discharging from the sea-tanks, the source of most of the actinide effluent. Actinides were determined by alpha-spectrometry after radiochemical separation. Concentrations of Pu(239+240) in filtered seawater were generally below 3 mBq/L, but increased to 5 mBq/L to the south of the pipeline, while Am241 concentrations were <0.8 mBq/L, rising to about 2 mBq/L. The proportion of the seawater actinide activity on suspended particulates was significantly lower than usual for the eastern Irish Sea, possibly due to the very low particulate loads observed, on average, resulting in approximately 80% of Pu(239+240) and 40% of Am241 being in solution. The concentration of actinide activity on particulates depends, in part, on the surface area available for adsorption, related in turn to the mineralogy of the particle. The low particulate loads encountered in the study may be due to settling in the water column. (Doria-PTT)
W91-12046

AEROBIC AND ANAEROBIC SOIL METABOLISM OF DICAMBA.
Illinois Inst. of Tech., Chicago. Dept. of Biology.
J. P. Krueger, R. G. Butz, and D. J. Cork.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 39, No. 5, p 995-999, May 1991. 1 fig, 7 tab, 18 ref.

Descriptors: *Aerobic digestion, *Anaerobic digestion, *Benzoic acid herbicides, *Dicamba, *Fate of pollutants, *Metabolism, *Path of pollutants, *Soil contamination, Biodegradation, Biomass, Carbon, Carbon dioxide, Carbon radioisotopes, Leaching, Mineralization, Soil types.

The dissipation and metabolism of dicamba from a typical midwestern agricultural soil were studied. The half-life of dicamba in aerobic soil was 31 days with a first-order rate constant of 0.0224/day. (C14)Dicamba was mineralized rapidly, as 14CO2 represented a major fraction of the applied radiocarbon (27%) after 365 days. The lack of degradation in the control (HgCl2) soil indicates that this mineralization is biologically mediated. Dicamba appears to be first converted to 3,6-dichlorosalicylic acid (3,6-DCSA) in aerobic soil by demethylation. The 3,6-DCSA may then be hydroxylated and rapidly metabolized, as only low levels of 2,5-dihydroxy-3,6-dichlorosalicylic acid were detected throughout the study. Intermediates that occur after ring opening are apparently unstable and therefore very difficult to isolate. Evolution of 14CO2 indicates complete mineralization of dicamba; therefore, unextractable radiocarbon is presumably radiocarbon incorporated into biomass. The metabolism of dicamba in soil under anaerobic conditions appears similar to that in aerobic soil, although the half-life and first-order rate constant are reduced (58 and 0.012/day, respectively). The short half-life of dicamba in aerobic soil suggests that little dicamba would leach to anaerobic zones of soil. Therefore, the anaerobic degradation of dicamba does not appear to be a major pathway in soil. (Doria-PTT)

W91-12049

CHARACTERISTICS OF THE CHEMICAL COMPOSITION OF WATER IN LAKES OF NORTH POLAND (CHARAKTERYSTYKA CHEMICZNEGO SKLADU WODY W JEZIORACH POLNOCNEJ POLSKI).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
A. Korycka.
Roczniki Nauk Rolniczych (H) Rybactwo RNRRB9, Vol. 102, No. 3, p 1-112, 1991. 31 fig, 37 tab, 157 ref. English summary.

Descriptors: *Eutrophication, *Lakes, *Limnology, *Nonpoint pollution sources, *Poland, *Water chemistry, *Water pollution sources, Agriculture, Catchment areas, Chemical properties, Fertility, Glaciation, Mesotrophy, Minerals, Salinity, Shallow water, Stratification, Surveys, Trophic level, Water quality trends, Water resources management.

Hydrochemical studies were carried out on 1,211 lakes in North Poland. The lowest content of mineral salts was observed in lakes of the last Pomeranian phase of Baltic glaciation; these were deeper, mesotrophic, with relatively poor catchment areas, and low intensity of agriculture. Lakes of South-Pomeranian Lakeland were also characterized by low salinity due to their location upon forested outwashes. Higher fertility was observed in lakes of the Leszno and Poznan phase of the last glaciation. The most fertile were lakes of the Great Poland Lakeland, where many lakes receive a discharge of pollutants. Changes in the use of catchment areas around less fertile lakes lead to an increase of lake salinity and thus to increased trophic level and decreased water quality. Water chemistry was correlated to maximal and average depth and to the share of the littoral in the lake area. Epilemnetic layers of shallow lakes were characterized by higher content of mineral salts compared to deep, stratified lakes. The highest fertility of near-bottom waters was observed in medium-deep, eutrophic lakes. Most lakes in the study (80%) were medium-deep eutrophic waters and shallow ponds. It is concluded that the deteriorating quality of Polish waster resources calls for immediate measures giving priority to lake protection and recultivation. (Doria-PTT)
W91-12061

BIOLOGICAL STATE OF GROUND WATERS IN THE ZLATICA-PIRDOP BASIN.
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
A. A. Petrova, E. B. Angelkova, R. L. Cvetkova, and D. A. Bukureshtliev.
Khidrobiologiia KHIDD9, Vol. 36, p 3-12, January 1991. 1 fig, 7 tab, 11 ref. (English summary).

Descriptors: *Bulgaria, *Groundwater pollution, *Nonpoint pollution sources, *Water pollution sources, Agricultural runoff, Aquatic life, Nitrates, Organic matter, Organic pollutants, Path of pollutants.

Four field studies were conducted from 1984 to 1987 from 7 drilled wells in the Zlatica-Pirdop basin to determine the biological state of groundwater. Although no organic pollution was found, at certain places there was a greater loading with organic substances, especially in the areas of private farmhouses. Over-fertilization caused nitrate pollution of the groundwater. The stygobiological studies which pointed out the dynamics of the organic substances in the groundwater showed that there were intensive self-purifying processes aided by the significant water stocks, the influx of pure northern tributaries of the Topolnitsa river, and the active water exchange of the groundwater flow. The groundwaters of the Pirdop-Zlatica basin were rich in stygobionts typical for the Marica water catchment area such as Microcerberus phreaticus, Soldanellonyx chappuisi tracicus, Porolohmannella cvetkovi, and for the Eastern Balkans and Europe such as Microcharon phlegethonis, Bathynella natans, the charpakticoid Elaphoidella jeanneli, and the cyclopoid Graeteriella unisetigera. (Author's abstract)

W91-12063

HYDROBIOLOGICAL STATE OF THE RIVER VALLEY OF THE RIVER LOM.
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 2E.
W91-12064

POPULATION, DEVELOPMENT AND MARINE POLLUTION IN CHINA.
Institute of Marine Environmental Protection, Dalian (China).
For primary bibliographic entry see Field 5G.
W91-12066

REPRODUCTIVE CYCLE AND HEAVY METALS IN THE ORGANS OF RED MULLET, MULLUS BARBATUS (L.), FROM THE NORTHWESTERN MEDITERRANEAN.
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
P. Miramand, M. Lafaurie, S. W. Fowler, P. Lemaire, and J. C. Guary.
Science of the Total Environment STENDL, Vol. 103, No. 1, p 47-56, April 1991. 1 fig, 5 tab, 19 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Mediterranean Sea, *Mullet, *Path of pollutants, *Reproduction, *Tissue analysis, Bioindicators, Cadmium, Copper, Iron, Kidneys, Liver, Manganese, Muscle, Vanadium, Water pollution effects, Zinc.

Concentrations of the heavy metals Cd, Cu, Fe, Mn, V, and Zn have been measured in the principal tissues of the red mullet, Mullus barbatus (L.), during a complete sexual cycle. By comparison of metal levels during the reproductive and non-reproductive periods, it was found that concentrations as well as total amount of Cu, Mn and Zn in liver and gonads of male and female mullets were dependent upon the stage of the sexual cycle. No relationship with the sexual cycle was noted for these metals measured in muscle, kidney, spleen or pyloric caecum. Because of the observed variation in liver and gonad metal concentrations, these tissues appear to be poor indicators of ambient levels of metals in the surrounding waters. However, muscle may prove useful as an indicator tissue owing to its apparent independence of effects of the sexual cycle. (Author's abstract)
W91-12070

OCCURRENCE AND BEHAVIOUR OF SEVERAL GROUPS OF ORGANIC MICROPOLLUTANTS IN THE SCHELDT ESTUARY.
Utrecht Rijksuniversiteit (Netherlands). Inst. of Earth Sciences.
R. van Zoest, and G. T. M. van Eck.
Science of the Total Environment STENDL, Vol. 103, No. 1, p 57-71, April 1991. 2 fig, 4 tab, 26 ref. Institute of Earth Sciences of the University of Utrecht Contract DGW-865.

Descriptors: *Estuaries, *Marine pollution, *Organic pollutants, *Path of pollutants, *Scheldt Estuary, Benzenes, Chlorinated hydrocarbons, Hexachlorobenzene, Lindane, Organochlorine pesticides.

Between May 1986 and January 1989, samples were taken on three occasions from the heavily polluted Scheldt estuary, in order to determine the pathways and fate of organic micropollutants. One group parameter (cholinesterase inhibition activity, CHOL) and 30 individual compounds (including chlorobenzenes, chloronitrobenzenes, volatile halocarbons and pesticides) were detected on at least one occasion. Another 10 organic pollutants were identified and quantified by GC/MS analysis. Many other, as yet unidentified, compounds were also present. The River Scheldt appeared to be the major source for most pollutants, although additional emissions along the estuary were also detected. Most pollutants were removed from the water during estuarine mixing (non-conservative behavior), probably due to various processes, such as

volatilization, degradation and photolysis. The fractional loss for most volatile halocarbons was approximately 75%, but in some cases 100% (e.g., trichloromethane). The fractional loss for CHOL was seasonally dependent: 5-10% in winter, and 35-40% in summer months. For most compounds, reasonable agreement was found when observed sediment-water partition coefficients (Koc) were compared with predicted values. Pronounced deviations were observed, however, indicating non-equilibrium conditions, probably because of slow sorption kinetics. The concentrations measured in the inflowing freshwater were compared with recently published ecotoxicological freshwater quality objective. The results show that some organic pollutants (e.g., hexachlorobenzene, CHOL, lindane, 1,1,1-trichloroethane) exceeded the published ecotoxicological risk values in all samples, suggesting that these pollutants may have an impact on the ecosystem of the Scheldt estuary. (Author's abstract)
W91-12071

CONTAMINANT IMPACT ASSESSMENT AND THE CONTAMINATING LIFESPAN OF LANDFILLS.
University of Western Ontario, London. Dept. of Civil Engineering.
R. K. Rowe.
Canadian Journal of Civil Engineering CJCEB8, Vol. 18, No. 2, p 244-253, April 1991. 7 fig, 1 tab, 24 ref, 2 append. Natural Sciences and Engineering Research Council of Canada Grant A1007.

Descriptors: *Groundwater pollution, *Infiltration, *Landfill linings, *Landfills, *Water pollution sources, *Weathering, Clay liners, Clay soils, Computer models, Design criteria, Geologic fractures, Leaching, Mathematical models, Soil properties, Till.

Unweathered clayey soils have been considered to represent a relatively ideal environment for the location of waste disposal sites. However, conventional hydrogeologic investigations of 'unweathered' soils typically have implied that they are unfractured. Recent research and field investigations, which have included angled boreholes or deep test pits in clayey tills, suggest that conventional investigations have been misleading and that many of these unweathered soils are indeed fractured to depths as much as 10 m. The effects of mass of contaminant, infiltration, and contaminant transport pathway on the 'contaminating lifespan' of a landfill were examined. The effects of fracturing in the till beneath a landfill were examined with an easy-to-use computer model that assessed the effect of either a natural or a man-made (e.g., compacted liner) intact layer in contact with the fractured till. The concept of developing 'triggers' to initiate leachate control measures in the event of failure of a leachate underdrain system is discussed and a trigger diagram was demonstrated for a hypothetical case. Even if the till beneath a proposed landfill is fractured, the use of appropriate hydrogeological and hydrogeotechnical investigations and design may permit a landfill system to be developed that will not have an unacceptable impact on critical receptors. (Rochester-PTT)
W91-12085

MINERALIZATION OF DISSOLVED ORGANIC PHOSPHORUS FROM A SHALLOW EUTROPHIC LAKE.
Agriculture and Food Science Centre, Belfast (Northern Ireland). Food and Agricultural Microbiology Research Div.
J. E. Cooper, J. Early, and A. J. Holding.
Hydrobiologia HYDRB8, Vol. 209, No. 2, p 89-94, February 1991. 3 fig, 1 tab, 22 ref.

Descriptors: *Bioavailability, *Eutrophic lakes, *Fate of pollutants, *Northern Ireland, *Path of pollutants, *Phosphorus, Aquatic bacteria, Biogeochemistry, Enzymes, Lough Neagh, Metabolism, Mineralization, Molecular weight, Phosphatases, Phosphodiesterase, Temperature.

Knowledge concerning the bioavailability of organic phosphorus compounds in freshwater lakes is important for the development of phosphorus reduction strategies to control excessive algal growth. Release of soluble reactive phosphorus (SRP) from dissolved organic phosphorus (DOP), concentrated by reverse osmosis of water samples from Lough Neagh, Northern Ireland, was measured in the presence of enzymes and cultures of lake water bacteria in a basal liquid medium adjusted to the pH of lake water (7.6). No hydrolysis of unfractionated DOP was observed in the presence of alkaline phosphatase but a combination of alkaline phosphatase and phosphodiesterase mineralized 14% of DOP in a 30-day incubation period at 15 C. A similar amount of mineralization was attained by phytase. Phytase induced the same degree of mineralization in a range of DOP fractions varying from molecular weight > 100,000 to about 500. A mixed culture of lake water bacteria mineralized 12% of unfractionated DOP. Single cultures of lake water bacteria displayed low mineralizing activity (mean of 49 cultures = 5% of DOP hydrolyzed). Apparently DOP from Lough Neagh in this molecular weight range is predominantly recalcitrant to bacterial mineralization under natural lake conditions. (Author's abstract)
W91-12091

USE OF ADJUVANTS TO MINIMIZE LEACHING OF HERBICIDES IN SOIL.
Florida Univ., Lake Alfred. Citrus Experiment Station.
For primary bibliographic entry see Field 5G.
W91-12119

REGIONAL CHARACTERISTICS OF LAND USE IN NORTHEAST AND SOUTHERN BLUE RIDGE PROVINCE: ASSOCIATIONS WITH ACID RAIN EFFECTS ON SURFACE-WATER CHEMISTRY.
Corvallis Environmental Research Lab., OR.
L. Liegel, D. Cassell, D. Stevens, P. Shaffer, and R. Church.
Environmental Management EMNGDC, Vol. 15, No. 2, p 269-279, March/April 1991. 1 fig, 9 tab, 43 ref.

Descriptors: *Acid rain, *Acid rain effects, *Environmental chemistry, *Land use, *Path of pollutants, *Regional analysis, Acid lakes, Acid neutralizing capacity, Acid streams, Calcium, Lake acidification, Magnesium, Soil chemistry, Sulfates, Sulfur, Vegetation effects, Wetlands.

The Direct/Delayed Response Project (DDRP) is one of several studies being conducted by the United States Environmental Protection Agency to assess risk to surface waters from acidic deposition in the eastern United States. In one phase of DDRP, land use, wetland, and forest cover data were collected for statistical samples of 145 Northeast lake and 35 Southern Blue Ridge Province stream watersheds in the United States. Land use and other data were extrapolated from individual to target watershed populations. Project statistical design allows summarization of results for various subsets of the target population. Forest cover was the primary land use in both the Northeast lake and Southern Blue Ridge Province stream regions. In the Northeast, developed (agriculture and urban) land was positively associated with surface-water chemistry values for acid neutralizing capacity, Ca plus Mg, pH, and sulfate in the Pocono/Catskill subregion. Extensive wetlands and beaver activity occur in parts of the Northeast region, whereas topography limits wetland and riparian development in the Southern Blue Ridge Province. Northeast soils have low sulfate adsorption capacity, most watersheds are near sulfur steady state, and lake sulfate concentrations are controlled principally by levels of sulfur deposition. Net annual sulfur retention in Northeast watersheds is positively correlated with the occurrence of wetlands and beaver impoundments. In contrast, most Southern Blue Ridge Province soils have high sulfate adsorption capacities, resulting in high net watershed sulfur retention. At the present time, stream sulfate concentrations and percent sulfur retention are controlled principally by soil chemical properties related to adsorption rather than atmospheric deposition and land use. (Author's abstract)
W91-12120

DISCHARGE OF DISSOLVED AND PARTICULATE 137-CS IN THE KUJI RIVER, JAPAN.
Japan Atomic Energy Research Inst., Tokai. Environmental Radiochemistry Lab.
For primary bibliographic entry see Field 2J.
W91-12130

RADIOGENIC ELEMENTS IN FINNISH SOILS AND GROUNDWATERS.
Geologian Tutkimuskeskus, Espoo (Finland).
For primary bibliographic entry see Field 2K.
W91-12131

USE OF WATER HYACINTHS TO DETERMINE TRACE METAL CONCENTRATIONS IN THE TROPICAL MORICHAL LARGO RIVER, VENEZUELA.
Instituto Venezolano de Investigaciones Cientificas, Caracas. Centro de Quimica.
For primary bibliographic entry see Field 5A.
W91-12133

EARLY DIAGENESIS OF SULFUR IN THE SEDIMENTS OF LAKES THAT RECEIVE ACID MINE DRAINAGE.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
C. M. Wicks, J. S. Herman, and A. L. Mills.
Applied Geochemistry APPGEY, Vol. 6, No. 2, p 213-224, 1991. 8 fig, 3 tab, 32 ref. Surface Mining Reclamation and Enforcement Contract J5150090, and NSF Grant EAR84-17122.

Descriptors: *Acid mine drainage, *Diagenesis, *Geochemistry, *Lake sediments, *Path of pollutants, *Sediment chemistry, *Sulfur, Chemical analysis, Chemical speciation, Environmental chemistry, Interstitial water, Strip mine lakes, Sulfur compounds, Water chemistry.

Fifteen final-cut strip mine lakes, located throughout the Western Interior, Eastern Interior, and Appalachian Coal Basins in the United States, were selected to represent a wide variety of values for the lake-water variables of pH, alkalinity, sulfate (SO4) and iron (Fe) concentrations, sediment organic matter content, overburden lithology, and lake age. Lake water, pore water and sediment samples were collected for geochemical analysis. Sequential digestion of sediment samples was used to determine the amount of the inorganic S phases (elemental S, metal monosulfide, metal disulfide, and total) present in the sediment. Authigenic inorganic reduced S minerals were found in the sediments of all 15 lakes that receive acid mine drainage from groundwater input. Although authigenic iron disulfide was the largest fraction in most of the lake sediments, elemental S was larger in some of the lakes. The amount of carbon-bonded S, determined by difference, ranged widely but was nearly always less abundant than the inorganic phases. Correlations of the nature and amount of authigenic reduced S minerals to the SO4 and Fe concentrations in pore water, the organic matter content of the lake sediments, and lake age were tested. The formation of SO4-reduction end products was not limited by Fe or SO4 availability. The amounts of reduced S in the sediments correlated with the amount of organic matter in the sediment, indicating that the authigenic mineral formation process is organic matter limited in these Fe and SO4-rich environments. Lake age, which represents a complex function of the diminishing acid mine drainage load derived from weathered spoil piles and the generation of alkalinity by biogeochemical reactions in the lake sediments, was a good predictor of the amount of reduced S mineral in the sediment regardless of geological setting. (Author's abstract)
W91-12134

BIODEGRADATION OF CHLORINATED BIPHENYLS (FENCLOR 42) IN BATCH CULTURES WITH MIXED AND PURE AEROBIC CULTURES.
Bologna Univ. (Italy). Dept. of Applied Chemistry and Materials Science.
For primary bibliographic entry see Field 5D.

W91-12135

SORPTION OF CHELATING AGENTS (HEDP AND NTA) ONTO MINERAL PHASES AND SEDIMENTS IN AQUATIC MODEL SYSTEMS. PART 1: SORPTION ONTO CLAY MINERALS.

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Oekologische Chemie.
K. Fischer.
Chemosphere CMSHAF, Vol. 22, No. 1/2, p 15-27, 1991. 6 fig, 3 tab, 11 ref. Federal Minister of Research and Technology Research Project No. 02-WT-8608.

Descriptors: *Adsorption kinetics, *Chelating agents, *Clay minerals, *Nitrilotriacetic acid, *Path of pollutants, *Sediment chemistry, *Sorption, Chemical interactions, Environmental chemistry, Hydrogen ion concentration.

The fate of organic chelating agents in the aquatic environment can be determined by reactions which regulate the distribution of a chemical between the solid and liquid phase. Adsorption/desorption processes are especially important for the adjustment of the distribution equilibrium. To assess the influence of such processes on the environmental fate of the phosphate substituting chelates 1-hydroxyethane-1,1-diphosphonic acid (HEDP) and nitrilotriacetic acid (NTA), adsorption studies were carried out in aquatic model systems, containing different adsorbents like clay minerals, sediments, and sewage sludges. The influence of the following parameters on the adsorption equilibrium was tested: the initial concentration of the chelators, adsorption pH, species and concentration of dissolved inorganic ions, redox potential, and reaction time. To assess the influence of the differences in the composition of adsorbents on the adsorption process and equilibrium, some chemical and mineralogical characteristics of the adsorbents (such as specific surface area, percentage of organic carbon, and oxidic/hydroxidic bound metals) were also investigated. Results indicate that the clay minerals (such as bentonite, Fithian illite, and kaolinite) differ more in their sorption strength at low HEDP concentrations than in their adsorption capacity at high HEDP concentrations. In contrast to the reaction with HEDP, the clay minerals adsorb NTA at low levels by almost the same extent. With both substances, the highest adsorption densities were found on kaolinite, which may be due to the relative low concentration of negative surface changes which hinder the adsorption of anions. The application of these results to sorption processes in natural systems (e.g., water/sediment, soil/soil solution) makes the enrichment of HEDP onto clay mineral fractions of the respective solid phases likely. (VerNooy-PTT)
W91-12136

POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS IN FISH FROM SOUTH-WEST GERMANY: RIVER RHINE AND NECKAR.

Chemische Landesuntersuchungsanstalt Stuttgart, Breitscheidstr. 4 D-7000 Stuttgart 10, Germany.
R. Frommberger.
Chemosphere CMSHAF, Vol. 22, No. 1/2, p 29-38, 1991. 2 fig, 2 tab, 15 ref.

Descriptors: *Bioaccumulation, *Dioxins, *Hazard assessment, *Neckar River, *Path of pollutants, *Polychlorinated biphenyls, *Rhine River, *Stream fisheries, Animal tissues, Distribution patterns, Fish, Germany, Tissue analysis.

In order to get information about the degree of contamination and in order to see if there might be a possible health hazard by their consumption, 14 samples of fish from the Rhine and Neckar rivers were analyzed for polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs). Eels, chubs, brown trout, a chum, a grayling and a barbel were analyzed. Contents in the fillet ranged from 3.6 to 20.1 ng/kg Federal Health Office toxicity equivalents (FHO-TEQ) or from 8.1 to 39.2 ng/kg international toxicity equivalents (I-TEQ) on a fat basis, or from 0.25 to 2.75 ng/kg FHO-TEQ and from 0.4 to 5.4 ng/kg I-TEQ on a fresh weight basis. The daily intake of an average fish consumer was 0.07 to 0.72 pg FHO-TEQ/kg body weight. Thus, there is still a factor of 1400 to 14,300 toward the no adverse effect level (NOEL) of 1 ng/kg body weight/day. Non-2,3,7,8-substituted congeners contributed up to 8.4% to the total FHO-TEQ. Both Rhine eel and Neckar eel show a very similar PCDD/fish sampling pattern distribution, while other species from Neckar like trout, grayling, carp and chum show a very different PCDD/fish sampling pattern distribution. This pattern distribution of PCDDs/fish sampling indicates a species specific metabolism and/or intake of the different congeners. (Author's abstract)
W91-12137

FISH BILE AS A TOOL FOR MONITORING AQUATIC POLLUTANTS: STUDIES WITH RADIOACTIVELY LABELLED 4,5,6-TRICHLOROGUAIACOL.

Stockholm Univ. (Sweden). Wallenberg Lab.
For primary bibliographic entry see Field 5A.
W91-12138

CHLOROTERPENES AND OTHER ORGANOCHLORINES IN BALTIC, FINNISH AND ARCTIC WILDLIFE.

Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
J. Paasivirta, and T. Rantio.
Chemosphere CMSHAF, Vol. 22, No. 1/2, p 47-55, 1991. 1 fig, 1 tab, 34 ref.

Descriptors: *Bioaccumulation, *Chlorinated aromatic compounds, *Chlorinated hydrocarbons, *DDT, *Marine life, *Path of pollutants, *Polychlorinated biphenyls, *Toxaphenes, Arctic zone, Baltic Sea, Birds, Marine environment, Marine mammals, Salmon, Scandinavia, Seals, Subarctic zone, Tissue analysis.

Chloroterpene mixtures were analyzed as toxaphene in Baltic, Finnish and Arctic fish, seal and bird samples together with DDT residues, hexachlorocyclohexanes (HCH), hexachlorobenzene (HCBz), chlordanes, hexachloronaphthalenes (HxCN), polychlorinated biphenyls (PCBs), polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Locality had a significant influence in most contents of organochlorines in fish. In the Baltic Sea, the lowest concentration in salmon were in deep water areas; generally, lake salmon were more polluted than sea salmon at the corresponding latitude. Arctic species were found to contain lower quantities of organochlorines than the same species in the Baltic Sea or Finland; one exception to this is toxaphene, which occurred at the same level in both Baltic and Arctic fish. Toxaphene was found to be the most evenly distributed organochlorine compound in Scandinavia, and seemed to bioaccumulate significantly in fish, but not in predatory birds in Finland. PCDD and PCDF compounds showed lower enrichment ratios than the chlorohydrocarbons. Their toxic load as TCDD-equivalents were found to be much lower than that of PCBs in all species studied. When concentrations were compared on a lipid basis, only DDT and PCB residues showed a significant enrichment from fish to seals. (VerNooy-PTT)
W91-12139

DETERMINATION OF TOXAPHENE IN FISH FROM NORTHERN EUROPE.

Rijksinstituut voor Visserijonderzoek, Ijmuiden (Netherlands).
F. van der Valk, and P. G. Wester.
Chemosphere CMSHAF, Vol. 22, No. 1/2, p 57-66, 1991. 5 fig, 3 tab, 14 ref.

Descriptors: *Bioaccumulation, *Chlorinated hydrocarbons, *Path of pollutants, *The Netherlands, *Toxaphenes, Baltic Sea, Eel, Herring, Organic compounds, Pollutant identification, Spatial distribution, Tissue analysis.

Concentrations of toxaphene were determined in fish from The Netherlands and adjacent marine areas by gas chromatography/negative chemical ionization-mass spectrometry, after a thorough clean-up. Levels of toxaphene lay between 0.1 and 7 mg/kg on a lipid basis. In general the measured levels were quite low, with the exception of herring oil from the Baltic Sea. In the Dutch great rivers, uniform concentrations of 0.3 mg/kg lipid in eel were found, despite the non-existence of polychlorinated terpene (PCT) use in their respective watersheds. Atmospheric transport was determined to be the most plausible cause. A major problem with the technique was the complexity of the mixture to be analyzed; this lead to an incomplete separation of the components. Toxaphene components showing different environmental behavior were distinguished, and indicated that the pattern of PCT congeners varied markedly among and between the samples and the toxaphene standard. This variety of congener patterns in different fish species suggest that the degradation capability of the fish determines the quality of PCT components which persist in the tissue. (VerNooy-PTT)
W91-12140

LEVELS AND PATTERNS OF PCDD AND PCDF CONTAMINATION IN FISH, CRABS, AND LOBSTERS FROM NEWARK BAY AND THE NEW YORK BIGHT.

Umea Univ. (Sweden). Inst. of Environmental Chemistry.
C. Rappe, P. A. Bergqvist, L. O. Kjeller, S. Swanson, and T. Belton.
Chemosphere CMSHAF, Vol. 22, No. 3/4, p 239-266, 1991. 7 fig, 8 tab, 23 ref.

Descriptors: *Bass, *Bioaccumulation, *Crabs, *Dioxins, *Lobsters, *New York Bight, *Newark Bay, *Path of pollutants, *Pollutant identification, *Polychlorinated biphenyls, *Water pollution sources, Bioindicators, Crustaceans, Fish, Marine pollution, Tissue analysis, Water pollution effects.

Samples of striped bass, crabs and lobsters were collected in Newark Bay and the New York Bight. The fish muscle and the hepatopancreas and meat from the crabs were subjected to congener specific analysis. All samples were found to be contaminated by 2,3,7,8-tetraCDD (tetrachloro dibenzo-p-dioxin) and a series of other highly hazardous 2,3,7,8-substituted congeners as well as less hazardous polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDDs and PCDFs). The levels of 2,3,7,8-tetraCDD were extremely high, 100 to 1000 times higher than background levels reported earlier. A value exceeding 6000 ppt wet tissue weight of 2,3,7,8-tetraCDD was found in a sample of crab hepatopancreas, which seems to be the highest value so far reported in a food product. The crab meat, on the other hand, contained only 100 ppt. In general the crustaceans contained many congeners, while the fish samples contained only 2,3,7,8-substituted compounds. This suggests that the crustaceans and mollusks may accumulate whatever is in their environment, making them potentially useful both for the identification of various PCDD and PCDF sources and for studying the environmental distribution of these compounds. An unknown compound, possibly a tetrachloro dibenzothiophene, was the dominating peak in most of the crustacean samples. (Author's abstract)
W91-12145

SORPTION OF NONPOLAR AND POLAR COMPOUNDS TO SOILS: PROCESSES, MEASUREMENTS AND EXPERIENCE WITH THE APPLICABILITY OF THE MODIFIED OECD-GUIDELINE 106.

B. von Oepen, W. Kordel, and W. Klein.
Chemosphere CMSHAF, Vol. 22, No. 3/4, p 285-304, 1991. 4 tab, 50 ref.

Descriptors: *Adsorption, *Organic compounds, *Path of pollutants, *Soil organic matter, *Soil properties, *Sorption, Leaching, Polarity, Soil chemistry, Standards, Testing procedures.

Soil sorption influences the extent of a compounds' vaporization from the soil surface, and its lateral (run-off) or vertical transport. An analysis was conducted of the sorption of four classes of chemicals by three representative soils varying in their sorption-relevant properties, e.g., organic carbon content, clay content, pH value, cation exchange

capacity, etc. The sorption coefficients of 50 organic compounds of different polarity, including carboxylic acids, and corresponding esters, amines, and amides were determined by batch equilibrium studies according to a modified version of the OECD-Guideline 106 Adsorption/Desorption. Results show that these batch-equilibrium studies were appropriate for determining sorption coefficients. The test-sequence of a modified version of OECD, Guideline 106 also proved to be applicable for the studies, including the leaching behavior of chemicals in soil or potential groundwater contamination. For hydrophobic compounds, e.g., the investigated ester, the variation in sorption coefficient values of different sorbents was within one order of magnitude, while more polar compounds, like amines, amides or carboxylic acids, the variation in sorption coefficients was as high as two orders of magnitude. These results indicate that the sorption of nonpolar compounds to the organic matter of the soil, is a good model for sorption to soils with high organic carbon content and low clay content. The variation of sorption behavior of a polar substance between two soils impedes the applicability of this result to other soils. Therefore, the sorption behavior of unknown substances should be determined using three different soils covering a large range of sorption-relevant properties. (VerNooy-PTT)
W91-12146

NONEQUILIBRIUM SORPTION OF ORGANIC CHEMICALS BY LOW ORGANIC-CARBON AQUIFER MATERIALS.
Arizona Univ., Tucson.
M. L. Brusseau, and M. E. Reid.
Chemosphere CMSHAF, Vol. 22, No. 3/4, p 341-350, 1991. 3 fig, 1 tab, 29 ref. Air Force Office of Scientific Research Contract F49620-88-C-0053.

Descriptors: *Aquifer characteristics, *Organic compounds, *Path of pollutants, *Sorption, Adsorption-desorption, Advection, Chlorinated aromatic compounds, Chlorinated hydrocarbons, Dispersion, Geochemistry, Groundwater pollution, Naphthalenes, Organic carbon, Simulation models, Solute transport, Xylenes.

An investigation was made of the nonequilibrium sorption of four representative organic chemicals (tetrachloroethene, 1,4-dichlorobenzene, p-xylene and naphthalene) by five aquifer materials of < 0.1% organic carbon. The results of miscible displacement experiments were analyzed using a one-dimensional advective-dispersive transport model, wherein sorption is considered instantaneous for a fraction of the sorbent and rate-limited for the remainder. An inverse correlation between the desorption rate constant and the equilibrium sorption constant was evident. All five aquifer materials exhibited similar nonequilibrium behavior, suggesting that the sorbent has only a secondary effect on the nature of nonequilibrium sorption. In addition, the data obtained for the aquifer materials were similar to data obtained for sorbents with higher organic-carbon contents. The empirical relationship obtained from these data may serve as a means to obtain estimates of desorption rate constants for aquifer materials, which would be useful as input to models which investigate the transport and fate of organic contaminants in the subsurface, and the relative importance of nonequilibrium sorption. The relationship may also be useful in planning and evaluating aquifer remediation systems. (VerNooy-PTT)
W91-12148

UPTAKE, ELIMINATION, AND BIOCONCENTRATION OF TEN ANILINES IN ZEBRAFISH (BRACHYDANIO RERIO).
Mainz Univ. (Germany, F.R.). Inst. fuer Zoologie.
W. Kalsch, R. Nagel, and K. Urich.
Chemosphere CMSHAF, Vol. 22, No. 3/4, p 351-363, 1991. 5 fig, 2 tab, 32 ref.

Descriptors: *Animal metabolism, *Bioaccumulation, *Biological magnification, *Dyes, *Path of pollutants, *Zebra fish, Benzenes, Bioassay, Fish, Kinetics, Mathematical models, Mathematical studies, Physicochemical properties.

Carbon-14 (14-C) labeled aniline (uniformly labeled), and some chloro-, and nitroanilines, were used to determine bioconcentration factors (BCF) in zebrafish (Brachydanio rerio) as well as uptake and elimination rate constants. Tests were performed under static conditions. During exposure, the course of uptake of all anilines showed a similar pattern. A rapid period of uptake into fish was followed by a steady equilibrium period. Quantitative structure activity relationships (QSAR) were calculated with the n-octanol/water partition coefficient (P sub o/w) in order to predict bioconcentration (or kinetics) of the chemicals from their physicochemical characteristics. A good QSAR was found for the BCF values however the rate constant did not correlate with P sub o/w. The elimination of anilines was best described by a two compartment first order kinetic model. In spite of their identical log P values (calculated values), accumulation of 2,4-dichloroaniline was observed to be three times as large as that of 3,4-dichloroaniline. Compartment sizes did not fit a QSAR equation and were independent from the aniline's lipophilicity. No general explanation for the observed formation of the two compartments was found. (Author's abstract)
W91-12149

ACCUMULATION OF ARSENIC BY AQUATIC PLANTS.
Pertanian Malaysia Univ., Serdang. Dept. of Chemistry.
C. K. Lee, K. S. Low, and N. S. Hew.
Science of the Total Environment STENDL, Vol. 103, No. 2/3, p 215-227, April 15, 1991. 5 fig, 2 tab, 31 ref.

Descriptors: *Aquatic plants, *Arsenic, *Bioaccumulation, *Hydrilla, *Malaysia, *Mine drainage, *Path of pollutants, Bioindicators, Chemical analysis, Phosphates, Tin mines.

Ten varieties of aquatic plants were collected from 22 pools resulting from tin-mining activities in Kuala Lumpur and Selangor, Malaysia. Concentrations of arsenic in these plants partially reflects the quantity of arsenic in pool water, which ranges from 0.002 to 0.25 micrograms/mL. The uptake of arsenic by hydrilla (Hydrilla verticillata Casp), was studied in the laboratory. Results confirmed that As uptake was indeed a function of initial arsenic concentration. As arsenate and phosphate are chemical analogues, the effect of phosphate on arsenic accumulation was also investigated, and it was found that in the presence of high phosphate concentrations, As uptake was inhibited. These results indicate that Hydrilla verticillata would be useful as a bioindicator of arsenic pollution in aqueous ecosystems. (VerNooy-PTT)
W91-12153

GEOCHEMISTRY OF SHORT CORE SEDIMENTS OFF ALEXANDRIA.
Alexandria Univ. (Egypt). Dept. of Oceanography.
A. R. Abdel-Moati, and A. A. El Sammak.
Acta Adriatica AADRAY, Vol. 31, No. 1/2, p 59-65, 1990. 3 fig, 2 tab, 13 ref.

Descriptors: *Geochemistry, *Heavy metals, *Nile River, *Sediment analysis, *Water pollution sources, Agricultural runoff, Aluminum, Bottom sediments, Chemical analysis, Copper, Industrial wastes, Iron, Land use, Manganese, Nickel.

Short core samples were collected from the coastal waters of the Alexandria, Egypt region during July 1986. The increasing man-made impact on the Nile River estuary was reflected by the enrichment of Fe, Mn, Cu and Ni in the upper few centimeters of core samples. The use of CuSO4 as an algicide for controlling massive aquatic plants in drains and canals discharging into the Nile is the probable source for Cu enrichment in the Nile water. Other pathways which contribute to the enrichment of metals in sediments include the addition of weathered and fractioned material from the Nile banks, or some diagenetic processes pumping mobile elements from sediments. Additional amounts of heavy metals were introduced into the river through domestic and industrial waste discharges derived from fertilizer, food canning and preservation industries. The downcore profiles for the metals/Al ratio show the characteristic enrichment of pollutant metals in most recent sediments. Compared with the Cu/Al ratio for standard shale and the Cu/Al ratio for Rosetta II and III, sediments reflect increasing Cu enrichment in the top core layer. The high retention of metals in surficial sediments indicate the importance of using trace metal vertical profiles in sediments to assess continuous changes in pollutants dumped in the watershed. The close correspondence of Fe and Mn concentrations as reflected by their significantly high correlation, indicate that the two metals are related in their mode of deposition. Sorption of Ni from the overlying water on sediments by Fe and Mn hydroxides may contribute to the significant portion of Ni in the Nile delta sediments. (Lantz-PTT)
W91-12158

T90 OF TOTAL COLIFORMS, FAECAL COLIFORMS AND FAECAL STREPTOCOCCI IN THE KASTELA BAY.
Institute of Oceanography and Fisheries, Split (Yugoslavia).
M. Tudor, M. Solic, and N. Krstulovic.
Acta Adriatica AADRAY, Vol. 31, No. 1/2, p 67-74, 1990. 2 fig, 4 tab, 10 ref.

Descriptors: *Coliforms, *Fecal coliforms, *Kastela Bay, *Path of pollutants, Bacteria, Bioindicators, Mortality, Solar radiation, Survival, Temperature.

Measurements of the rate of inactivation of fecal coliforms (FC), fecal streptococci (FS), and total coliforms (TC) was carried out by obtaining samples using polyethylene bags placed at the sea water surface of Kastela Bay. Sunlight was recognized as a primary factor controlling the reduction of indicator bacteria of fecal pollution in the Bay. Depending on the radiation intensity range, from 500 to 800 W/sq m, 90% of the fecal coliforms were inactivated within 1-5 hrs, 90% of fecal streptococci within 2.5-13.5 hrs, and 90% of total coliforms within 1.2-6.5 hrs (T90). In the dark, there appears to be no difference in T90 between these three groups of indicator bacteria. Lower temperatures seem to be favorable for increased survival under dark conditions. (Lantz-PTT)
W91-12159

CONTAMINATION OF DATESHELL (LITHOPHAGA LITHOPHAGA) FROM THE EASTERN COAST OF THE ADRIATIC SEA BY POLYCYCLIC AROMATIC HYDROCARBONS.
Institute of Oceanography and Fisheries, Split (Yugoslavia).
J. Dujmov, and P. Sucevic.
Acta Adriatica AADRAY, Vol. 31, No. 1/2, p 153-161, 1990. 3 fig, 2 tab, 23 ref.

Descriptors: *Adriatic Sea, *Data mussels, *Sea mussles, *Path of pollutants, *Polycyclic aromatic hydrocarbons, Bioaccumulation, Bioindicators, Organic compounds, Shellfish.

Ultraviolet fluorescence spectroscopy was used to analyze polycyclic aromatic hydrocarbons (PAHs) in the dateshell (Lithophaga lithophaga), from a wide variety of different polluted and unpolluted habitats of the eastern coast of the Adriatic Sea. Emission spectra were scanned at wavelengths of 350-510 nm; results were expressed in chrysene and Kuwait oil equivalents. The lowest value determined in the investigated area was 0.41 microgm/gm dry weight in the Dugi otok island; the maximum was 20.41 microgm/gm dry weight in a locality near the port of Sibenik. PAH contents in dateshells from the eastern Adriatic Coast ranged from 1 to 20 microgm/gm dry weight chrysene equivalents. The highest values were found in nearshore localities which were under the direct influence of the land-based sources of pollutants. Background levels of PAH for the open Adriatic Sea were about 1 microgm/gm dry weight. It was determined that the dateshell would be useful as a sentinel organism in monitoring studies. (Lantz-PTT)
W91-12160

UPTAKE AND ELIMINATION KINETICS OF ORGANOPHOSPHOROUS PESTICIDES IN THE GUPPY (POECILIA RETICULATA): CORRELATIONS WITH THE OCTANOL/WATER PARTITION COEFFICIENT.

Utrecht Rijksuniversiteit (Netherlands). Environmental Toxicology Section.
J. De Bruijn, and H. Hermens.

Environmental Toxicology and Chemistry ETOCDK, Vol. 10, No. 6, p 791-804, June 1991. 5 fig, 4 tab, 63 ref.

Descriptors: *Bioaccumulation, *Guppies, *Organophosphorus pesticides, *Partition coefficient, *Path of pollutants, *Pesticides, *Toxicology, Biotransformation, Fate of pollutants, Model studies, Toxicity.

Bioconcentration factors, uptake rate constants and elimination rate constants of a series of organophosphorus pesticides were determined in the guppy (Poecilia reticulata). The results of these three toxicokinetic parameters were related to measured octanol/water partition coefficients (Kow). A simple one-compartment model fitted the uptake and elimination characteristics of the chemicals. A biphasic relationships was observed between the uptake rate constant and log Kow, whereas elimination rate constants were inversely related to Kow. For some of the test compounds, substantially higher elimination rates were found, compared to isolipophilic chlorobenzenes, which resulted in lower bioconcentration factors. These results suggest that for some of the tested organophosphorus compounds biotransformation reactions appear to occur at a rate that in fact diminishes the disposition of the chemical in the fish. For the compounds that behave in a comparable way to chemicals that are slowly metabolized, in vivo biotransformation can of course not be excluded. The results merely indicate that these processes occur at a rate that is relatively slower than the rate of elimination of the parent compound. (Lantz-PTT)
W91-12164

FACTORS CONTROLLING LEAD AVAILABILITY TO THE DEPOSIT-FEEDING BIVALVE MACOMA BALTHICA IN SULPHIDE-RICH OXIC SEDIMENTS.

McMaster Univ., Hamilton (Ontario). Dept. of Geology.
B. P. Bourgoin, M. J. Risk, and A. E. Aitken.

Estuarine, Coastal and Shelf Science ECSSD3, Vol. 32, No. 6, p 625-632, June 1991. 4 fig, 3 tab, 12 ref.

Descriptors: *Bioaccumulation, *Bivalves, *Environmental chemistry, *Lead, *Path of pollutants, *Sulfides, Geochemistry, Sediment chemistry, Tissue analysis.

The oxidized layer of sediment at the sediment-water interface from which many benthic organisms feed is chemically different from subsurface sediments. Sulfides dominate metal partitioning in the reducing environment of most estuarine subsurface sediments, whereas oxides of Fe and Mn as well as various organic materials are important substrates for binding metals under oxidized conditions. Many studies have shown that the prediction of trace metal levels in biota was improved when the trace metal concentrations extracted from oxidized sediments were normalized with respect to the Fe and/or organic content of the sediment. However, other studies have demonstrated that the selectivity of the extractants used in these studies deteriorates markedly in sulfide-rich anoxic sediments. Tissue Pb levels in the deposit-feeding bivalve Macoma balthica have been compared with the physicochemical components of oxic sediments near an ore concentrate stockpile and loading facility. Results indicate that weak acids such as 1 N HCl extract a significant portion of the Pb from the sulfide fraction and may overestimate its bioavailability in sulfide-rich sediments. Normalizing the extracted Pb levels with the total Sulfur content in the sediments significantly improved the predictability of Pb uptake in the bivalves. (Lantz-PTT)
W91-12173

IN SITU BIODEGRADATION: MICROBIOLOGICAL PATTERNS IN A CONTAMINATED AQUIFER.

Cornell Univ., Ithaca, NY. Dept. of Microbiology.
E. L. Madsen, J. L. Sinclair, and W. L. Ghiorse.

Science SCIEAS, Vol. 252, p 830-833, May 1991. 3 fig, 1 tab, 39 ref. Electric Power Research Institute (EPRI) Contract 2879-1 and EPRI Project RP 2879-5.

Descriptors: *Aquifers, *Biodegradation, *Fate of pollutants, *Groundwater pollution, *Microorganisms, *Path of pollutants, Adaptation, Aromatic compounds, Bacteria, Coal tar, Organic pollutants, Protozoa, Spatial distribution.

Conventional approaches for proving in situ biodegradation of organic pollutants in aquifers have severe limitations. Patterns in a comprehensive set of microbiological activity and distribution data were analyzed for a site where a truckload of coal tar was buried in a forested area in the northeastern United States. Measurements were performed on sediment samples gathered at consistent depths in aquifer boreholes spanning a gradient of contaminant concentrations at the buried coal tar site. Microbial adaptation to polyaromatic hydrocarbons (PAHs) was demonstrated by mineralization of naphthalene and phenanthrene in samples from PAH-contaminated, but not adjacent, pristine zones. Contaminant-stimulated in situ bacterial growth was indicated because enhanced numbers of protozoa and their bacterial prey were found exclusively in contaminated subsurface samples. The data suggest that many convergent lines of logically linked indirect evidence can effectively document in situ biodegradation of aquifer contaminants. (Author's abstract)
W91-12212

TWO-PHASE FLOW IN HETEROGENEOUS POROUS MEDIA: I. MODEL DEVELOPMENT.

Waterloo Univ. (Ontario). Inst. for Ground Water Research.
B. H. Kueper, and E. O. Frind.

Water Resources Research WRERAQ, Vol. 27, No. 6, p 1049-1057, June 1991. 8 fig, 1 tab, 35 ref.

Descriptors: *Finite difference methods, *Groundwater pollution, *Model studies, *Multiphase flow, *Path of pollutants, Fluid flow, Mathematical models, Organic compounds, Porous media.

A two-dimensional finite difference model to study the simultaneous movement of a dense, nonaqueous phase liquid and water in heterogeneous porous media was developed. A distinctive feature of the solution is that the primary variables solved for, wetting phase pressure and wetting phase saturation, are both existent throughout the solution domain regardless of whether the nonwetting phase is present. This eliminates the need to specify small, fictitious saturations of nonwetting fluid ahead of the advancing front where only wetting fluid is present, as is often required in conventional simulators. The model is therefore well suited for the simulation of groundwater contamination problems involving the advance of immiscible liquids into previously uncontaminated groundwater systems. The finite difference equations are solved fully implicitly using Newton-Raphson iteration. In order to minimize computer storage and execution time a Dupont-Kendall-Rachford iterative solver utilizing Orthomin acceleration has been incorporated. The numerical model was verified against an exact analytical solution which fully incorporates the effects of both relative permeability and capillary pressure. The model was validated through comparison to a parallel-plate laboratory experiment involving the infiltration of tetrachloroethylene into a heterogeneous sand pack. (See also W91-12223) (Author's abstract)
W91-12222

TWO-PHASE FLOW IN HETEROGENEOUS POROUS MEDIA: II. MODEL APPLICATION.

Waterloo Univ. (Ontario). Inst. for Ground Water Research.
B. H. Kueper, and E. O. Frind.

Water Resources Research WRERAQ, Vol. 27, No. 6, p 1059-1070, June 1991. 19 fig, 6 tab, 27 ref.

Descriptors: *Finite difference methods, *Groundwater pollution, *Model studies, *Model testing, *Multiphase flow, *Path of pollutants, Fluid flow, Mathematical models, Organic compounds, Permeability, Porous media, Sand aquifers, Simulation analysis.

The migration of a dense, nonaqueous phase liquid through heterogeneous porous media was examined using numerical simulation. Laboratory measurements of capillary pressure-saturation curves were performed on samples obtained from a sand aquifer and scaled to permeability to provide a data base of model input parameters. Numerical simulations incorporating 25,200 finite difference cells were carried out in a spatially correlated, random permeability field to illustrate the influence of fluid properties on the migration of a nonwetting liquid below the water table. The simulation results are characterized by spatial moments to reflect the relative degrees of lateral spreading exhibited by the migrating nonwetting body in the presence of lenses of differing permeability. In addition, numerical simulations were performed in a solution domain containing a single lens of lower permeability material in order to examine the local-scale sensitivity to porous media and fluid properties. The results of the study show the migration of a nonwetting liquid to be extremely sensitive to subtle variations in the capillary properties of the porous medium and to be influenced strongly by the fluid physical properties. (See also W91-12222) (Author's abstract)
W91-12223

GROUNDWATER CONTAMINATION AT THE KESTERSON RESERVOIR, CALIFORNIA: I. HYDROGEOLOGIC SETTING AND CONSERVATIVE SOLUTE TRANSPORT.

Lawrence Berkeley Lab., CA. Earth Sciences Div.
S. M. Benson, A. F. White, S. Halfman, S. Flexser, and M. Alavi.

Water Resources Research WRERAQ, Vol. 27, No. 6, p 1071-1084, June 1991. 18 fig, 2 tab, 35 ref. U.S. Department of Interior Interagency Agreement 9-AA-20-20, U.S. Department of Energy Contract N.DE-AC03-76SF00098.

Descriptors: *Aquifers, *Brackish water, *Geohydrology, *Groundwater pollution, *Kesterson Reservoir, *Path of pollutants, *Selenium, *Solute transport, Boron, California, Drainage water, Nitrates, Shallow aquifers, Total dissolved solids.

Shallow groundwater under Kesterson Reservoir, Merced County, California, was contaminated over a period of 6 years while the reservoir was used for the disposal of brackish subsurface agricultural drainage water from farmlands in the San Joaquin Valley. Drainage water contained an average of 10,000 mg/L total dissolved solids (TDS), high concentrations of selenium (300 microg/L), nitrate (37 mg/L as nitrogen), boron (15 mg/L), and lesser amounts of mercury, chromium, and molybdenum. Infiltration and lateral migration of this water created a 20-m-deep plume of high-TDS, boron-rich water covering an area of about 5 sq km. Transport of selenium and nitrate was inhibited by biogeochemical reactions in the pond bottom sediments. The regional hydrogeologic system at Kesterson Reservoir is dominated by the presence of four lithostratigraphic units. These are, in order of increasing depth, a fine-grained surfical layer extending to depths of as much as 8 m, a semi-confined sandy aquifer extending to 60 m, a widespread lacustrine clay confining layer, and a confined sandy aquifer. Within each of these units, order of magnitude variations in the hydrologic properties of the sediments occur ubiquitously over lateral distances of tens of meters and vertical distances of a fraction of a meter. Selenium migrated into the aquifer in an area where the fine-grained surface layer was thin or absent. Once in the aquifer, local rates of migration are controlled by the small-scale structure and hydrogeologic properties of the sediments. The large range of velocities combined with a limited lateral extent of individual layers are expected to create a broadly dispersed plume of solutes migrating downgradient from Kesterson, which is confirmed by a noninvasive electromagnetic survey of electrical conduc-

tivity distributions in the shallow aquifer. (See also W91-12225) (Author's abstract)
W91-12224

GROUNDWATER CONTAMINATION AT THE KESTERSON RESERVOIR, CALIFORNIA: II. GEOCHEMICAL PARAMETERS INFLUENCING SELENIUM MOBILITY.
California Univ., Berkeley. Lawrence Berkeley Lab.
A. F. White, S. M. Benson, A. W. Yee, H. A. Wollenberg, and S. Flexser.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1085-1098, June 1991. 13 fig, 1 tab, 46 ref.

Descriptors: *Geochemistry, *Groundwater pollution, *Kesterson Reservoir, *Path of pollutants, *Selenium, *Shallow aquifers, *Solute transport, California, Chemical reduction, Microorganisms, Precipitation.

Transport of selenium in groundwater at the Kesterson Reservoir in the Central Valley of California was strongly retarded because of chemical reduction and precipitation mediated by microbial activity. Under such conditions, negative correlations were documented between aqueous Se and Fe(2+), Mn, and hydrogen sulfide. Locally, the presence of oxidizing species, notably oxygen and nitrate, suppressed this reduction, permitting Se mobilization in the shallow aquifer. Selenate, the dominant and most oxidized form of Se, was in electrochemical disequilibrium with subordinate concentrations of selenite. Normally slow inorganic reduction rates were accelerated by microbial activity which utilizes oxidized chemical species including selenate as electron donors during the oxidation of organic matter. Two stratified redox barriers to selenium migration were documented beneath Kesterson: an underlying shallow anoxic zone underlying most of the pond bottom, characterized by high organic content and sulfate reduction, and a deeper dynamic front established by localized oxygen infiltration from the overlying ponds and Fe(2+) release from aquifer materials. The reducing nature of this deeper aquifer ultimately precludes Se transport to regional groundwater. (See also W91-12224) (Author's abstract)
W91-12225

NUMERICAL MODELING OF NATURAL AND ENHANCED DENITRIFICATION PROCESSES IN AQUIFERS.
Gesamthochschule Kassel (Germany, F.R.). Dept. of Civil Engineering.
W. Kinzelbach, W. Schafer, and J. Herzer.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1123-1135, June 1991. 13 fig, 1 tab, 59 ref.

Descriptors: *Aquifers, *Biodegradation, *Denitrification, *Fate of pollutants, *Groundwater pollution, *Mathematical models, *Microbial degradation, *Model studies, *Path of pollutants, Groundwater, Nitrates, Organic carbon, Remediation, Solute transport.

Nitrate modeling in the groundwater environment must incorporate microbial denitrification as the major process of nitrate elimination. A multispecies transport model was developed which describes the interaction of oxygen, nitrate, organic carbon, and bacteria. Three phases (mobile pore water, biophase, and aquifer material) are taken into account. The model is applied to a natural aquifer situation as well as to an in situ remediation case where nitrate is employed as an oxidant. In the natural aquifer it is shown that the release of organic carbon from the matrix is the controlling factor for denitrification. In the remediation case, on the other hand, the data suggest that diffusion limitation of the nutrient supply to the biophase controls bacterial growth. (Author's abstract)
W91-12228

RATE-LIMITED SORPTION AND NONEQUILIBRIUM TRANSPORT OF ORGANIC CHEMICALS IN LOW ORGANIC CARBON AQUIFER MATERIALS.
Arizona Univ., Tucson. Dept. of Soil and Water Science.
M. L. Brusseau, T. Larsen, and T. H. Christensen.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1137-1145, June 1991. 4 fig, 3 tab, 60 ref.

Descriptors: *Aquifers, *Fate of pollutants, *Groundwater pollution, *Model studies, *Organic compounds, *Path of pollutants, *Solute transport, *Sorption, Diffusion, Hydrophobic compounds, Mass transfer, Organic carbon, Pore water velocity, Simulation analysis.

The rate-limited sorption and nonequilibrium transport of several hydrophobic organic chemicals in three low-organic carbon (<0.025%) aquifer materials was investigated. Results of miscible displacement experiments performed at two pore water velocities and with very low solution phase concentrations (30-60 microg/L) were analyzed using a first-order mass transfer nonequilibrium model, as well as a model employing the local equilibrium assumption. Results of the analyses revealed sorption to be significantly rate limited, possibly by a diffusion-limited mechanism. The impact of rate-limited sorption on transport was dependent upon pore water velocity. The experiments performed at a faster velocity (approximately 1 cm/h) could be successfully simulated only with the nonequilibrium model, whereas the equilibrium model was adequate for the slower-velocity (approximately 0.2 cm/h) experiments. Comparison of experimental results to those reported in the literature revealed that time scale has a significant impact on the degree of nonequilibrium observed and on the values of experimental rate constants determined. Regression equations were developed for the two kinetics-associated parameters contained in the nonequilibrium model: first-order mass transfer constant and fraction of instantaneous sorption. (Author's abstract)
W91-12229

PORE SCALE SPATIAL ANALYSIS OF TWO IMMISCIBLE FLUIDS IN POROUS MEDIA.
Stanford Univ., CA. Dept. of Civil Engineering.
H. Gvirtzman, and P. V. Roberts.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1165-1176, June 1991. 17 fig, 60 ref. EPA Grant EPA R-815738.

Descriptors: *Flow models, *Groundwater pollution, *Model studies, *Multiphase flow, *Path of pollutants, *Porous media, Fluid flow, Mathematical models, Organic compounds, Pores, Saturation, Soil types, Spatial distribution.

A conceptual model describes the spatial distribution of two immiscible fluids in the pore space of sphere packings. The model is based on the ideal soil concept of homogeneous arrangement of identical spheres but is generalized to include random packing. It quantitatively analyzes the interfacial area between wetting and nonwetting fluids and between the fluids and the solid spheres, as a function of the saturation degree. These relationships depend on the packing arrangement of the spheres, the sphere radius, and the fluid-solid contact angle. The model focuses on the region of low saturation of the wetting phase, where the wetting phase consists of pendular rings. When the nonwetting phase appears as ganglia, the model assumes single-chamber ganglia. Potential applications include: (1) to quantify the air-water interface in the unsaturated zone; (2) to analyze connate water interfacial areas in petroleum reservoirs and to assess the effect of surfactants during enhanced oil recovery; and (3) to estimate the interface between groundwater and floating nonaqueous phase liquids above the water table. (Author's abstract)
W91-12231

THREE-DIMENSIONAL SPATIAL MOMENTS ANALYSIS OF THE BORDEN TRACER TEST.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
H. Rajaram, and L. W. Gelhar.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1239-1251, June 1991. 15 fig, 2 tab, 29 ref. EPA Agreement CR-813359-01, NSF Grant CSE-8814615.

Descriptors: *Aquifer characteristics, *Camp Borden Site, *Groundwater pollution, *Ontario, *Path of pollutants, *Plumes, *Solute transport, *Tracers, Aquifer testing, Aquifers, Data interpretation, Dispersivity, Model studies, Three-dimensional model.

A large-scale tracer test conducted at a Borden, Ontario, aquifer site included detailed three-dimensional plume monitoring, but most previous studies have emphasized the interpretation of the data in a two-dimensional sense. An independent analysis of the fully three-dimensional nature of the plume was developed using a linear spatial interpolation scheme which differs significantly from the gridded higher-order interpolation scheme used in earlier analyses. A detailed examination of the data base reveals significant truncation of the plume during several sampling sessions. This feature explains the low mass estimates obtained during the later sampling sessions. Consequently, there are significant uncertainties associated with the corresponding second-moment estimates. This uncertainty, which calls into question any refined comparisons of second-moment evolution with stochastic theories, has not been recognized in previous interpretations of second-moment estimates. The estimated vertical macrodispersivity was about twice that attributable to molecular diffusion. The estimated horizontal transverse macrodispersivity is much larger than the vertical macrodispersivity. Temporal variations in the flow appear to provide a plausible explanation of the large horizontal transverse macrodispersivity. Anomalous behavior of the second-moment evolution suggests the role of a large-scale heterogeneity during the latter portion of the test, indicating possible mutual interactions between the second-moment components. (Author's abstract)
W91-12238

SIMULATION OF THE TRANSIENT SOIL WATER CONTENT PROFILE FOR A HOMOGENEOUS BARE SOIL.
Texas Univ. at Austin. Environmental and Water Resources Engineering Group.
R. J. Charbeneau, and R. G. Asgian.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1271-1279, June 1991. 6 fig, 4 tab, 21 ref. EPA Agreement CR-813080.

Descriptors: *Groundwater pollution, *Hydrologic models, *Infiltration, *Model studies, *Path of pollutants, *Saturation, *Soil types, *Soil water, *Vadose zone, Austin, Evaporation, Hydrologic budget, PROFIL Model, Recharge rate, Runoff, Texas, Traveltime.

Characterization of the fate and transport of solutes through the vadose zone requires estimation of average water contents and travel times through the unsaturated profiles. PROFIL is a simple, physically based model for simulation of the hydrologic balance and water saturation profile for a homogeneous bare soil. For an arbitrary rainfall record, the model calculates the cumulative infiltration, runoff, evaporation, and recharge components, as well as the time average reduced saturation and its variance as a function of depth. The results may be used to estimate the source strength and travel time through the vadose zone for groundwater contamination analyses. For the Austin, Texas, meteorological data analyzed, recharge amounts of 10, 19, and 37% of the annual rainfall were estimated for clay loam, loam, and loamy sand, respectively. The model is computationally efficient and easily allows long-term simulation for parameter sensitivity investigations. (MacKeen-PTT)
W91-12241

PREDICTION OF TRACER PLUME MIGRATION IN DISORDERED POROUS MEDIA BY THE METHOD OF CONDITIONAL PROBABILITIES.
California Univ., Berkeley. Dept. of Civil Engineering.
Y. Rubin.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1291-1308, June 1991. 11 fig, 36 ref, append. Department of Energy Contract DE-AC03-76-SF-00098.

Descriptors: *Model studies, *Network design, *Path of pollutants, *Porous media, *Solute transport, *Tracers, Darcys law, Dispersivity, Field tests, Flow equations, Mathematical studies, Plumes, Probabilistic process, Sampling, Simulation analysis.

A method for estimation of the spatial movements and concentration of a tracer plume has been developed. The study was set in a probabilistic frame due to the inherent inability to characterize the flow domain deterministically. The starting point of the formulation is the Dagan conceptual model which relates the concentration of the plume to the translation of tagged elements of solute mass. Then, using Darcy's law and the flow equations, translation is described using a function model for the velocity. Comparison with numerical simulations shows this model to be favorable for variances of the log conductivity as large as 2.56 (Dykstra-Parsons coefficient of 0.8). The correlation of this random function model with the hydraulic head and conductivity fields is demonstrated. Conditioning improves predictions of the spatial moments of the tracer plume by making a more comprehensive use of available data. It is concluded that the method allows for a wide range of applications, including the design of monitoring networks and site sampling campaigns. (Author's abstract)
W91-12243

COMPARISON BETWEEN NATURAL AND FORCED GRADIENT TESTS TO DETERMINE THE VERTICAL DISTRIBUTION OF HORIZONTAL TRANSPORT PROPERTIES OF AQUIFERS.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Environmental Sciences and Energy Research.
D. Ronen, M. Magaritz, and F. J. Molz.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1309-1314, June 1991. 6 fig, 3 tab, 17 ref. EPA Contract CR-813647-01-0.

Descriptors: *Aquifer characteristics, *Groundwater movement, *Groundwater pollution, *Path of pollutants, *Solute transport, *Tracers, Alabama, Aquifers, Confined aquifers, Field tests, Flow discharge, Hydraulic conductivity, Mobile, Test wells.

A modified natural gradient point dilution test used a multilayer sampler in a 20-m-thick confined aquifer in a research field near Mobile, Alabama. The horizontal component of the specific discharge along the profile varies by an order of magnitude, from 2.0 to 21.1 m/yr. The modified point dilution test was capable of detecting very large specific discharge (q) changes over small vertical intervals. The results obtained by the point dilution test agree with the results obtained in the same aquifer by a forced gradient tracer test over a distance of 6 m. This agreement demonstrates that aquifer transport parameters obtained in an undisturbed flow field at the Mobile site represent not only the aquifer properties in the immediate vicinity of the test well but the detailed aquifer transport properties at a much larger scale. (MacKeen-PTT)
W91-12244

FIELD SCALE MASS ARRIVAL OF SORPTIVE SOLUTE INTO THE GROUNDWATER.
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering.
G. Destouni, and V. Cvetkovic.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1315-1325, June 1991. 6 fig, 34 ref, 2 append.

Descriptors: *Aeration zone, *Groundwater pollution, *Mass transport, *Model studies, *Path of pollutants, *Soil contamination, *Soil water, *Solute transport, *Water pollution sources, Equilibrium, Hydraulic conductivity, Kinetics, Mathematical studies, Sorption.

The effect of spatial variability in sorption parameters was investigated for field scale solute transport in the unsaturated zone. The considered sorption reaction is kinetically controlled sorption-desorption coupled with a parallel linear equilibrium isotherm. The source of solute is assumed to be distributed over a heterogeneous field where the horizontal extent of the source area is significantly larger than the depth to the groundwater table. The transport model is expressed in terms of the mass flux and in dimensionless form, where the effect of equilibrium sorption is incorporated in the dimensionless parameters of the kinetic sorption model. The influence of different correlation properties between the sorption parameters and the hydraulic conductivity at saturation, Ks, in the expected field scale mass flux of solute was investigated. The results indicate that spatially variable sorption rate coefficients with negative or no correlation to Ks may result in an earlier mass arrival and a considerably altered form of the breakthrough curve compared to the case of constant sorption parameters. In addition, a comparison between the flux-averaged and the resident concentration models indicates that spatial variability in the sorption rate coefficients has similar effects on the temporal variation of the field-scale resident concentration as on the field scale mass flux of solute. (Author's abstract)
W91-12245

STOCHASTIC MODEL OF SOLUTE TRANSPORT IN GROUNDWATER: APPLICATION TO THE BORDEN, ONTARIO, TRACER TEST.
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
W. D. Graham, and D. B. McLaughlin.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1345-1359, June 1991. 11 fig, 1 tab, 24 ref. NSF Grant ECE-8514987, National Institute of Environmental Health Sciences Grant 1-P42-ES04675.

Descriptors: *Aquifer characteristics, *Camp Borden Site, *Groundwater pollution, *Model studies, *Ontario, *Path of pollutants, *Solute transport, *Stochastic models, *Tracers, Aquifer testing, Aquifers, Dispersion, Finite element method, Model testing, Plumes.

Results from the Borden, Ontario, tracer test were used to evaluate the performance of a stochastic model of solute transport in groundwater. The model assumes that spatial variations in hydraulic conductivity induce variations in a steady state velocity field which, in turn, induce variations in solute concentration. Analytical expressions for the unconditional ensemble moments of velocity are derived from the unconditional moments of log hydraulic conductivity. The velocity moments are related to the ensemble moments of concentration by a set of coupled partial differential equations. The dependent variables in these equations are the concentration mean and covariance and the velocity-concentration covariance (or macrodispersive flux). Macrodispersion is not assumed to be Fickian. The moment equations are solved with a dual-grid finite element algorithm. The nonstationary concentration covariances obtained from the finite element solution provide the information needed to condition estimates of velocity and concentration on a small set of concentration measurements. In the Borden application conditioning is performed sequentially, at 85 and 260 days after the injection of a conservative tracer (chloride). The conditional mean concentration provides a better estimate of the true chloride concentration than the unconditional mean. The concentration covariance and macrodispersive flux both decrease at conditioning times but gradually increase after the solute plume moves out of the sampling grid. The performance of the stochastic model, as indicated by an analysis of measurement residuals, is generally consistent with the model's own estimates of concentration uncertainty. (Author's abstract)
W91-12248

SO2 OXIDATION IN A RAINBAND: EFFECTS OF IN-CLOUD H2O2 PRODUCTION.
McGill Univ., Montreal (Quebec). Dept. of Meteorology.
A. M. Macdonald, and H. G. Leighton.
Atmosphere - Ocean ATOCDA, Vol. 29, No. 1, p 133-149, March 1991. 8 fig, 4 tab, 25 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Cloud chemistry, *Hydrogen peroxide, *Precipitation, *Sulfates, Chemical reactions, Environmental effects, Path of pollutants, Vertical distribution, Water pollution sources.

Aqueous-phase H2O2 production in a rainband and its possible effect on sulfate production were studied by means of a two-dimensional numerical model. In-cloud peroxide production was incorporated into this chemistry model and its simulation results were compared with those in which aqueous-phase H2O2 came only from the dissolution of gaseous H2O2 from the cloud interstitial air. Results were from two different polluted situations. Case 1 had initial SO2 and sulfate aerosol profiles representative of a moderately polluted air mass and Case 2 had chemical profiles expected to increase the relative importance of oxidation to nucleation as a means of contributing sulfate to cloud and rain. Sulfate production increased in both cases, although in Case 1 the effect of this increase on the concentration of sulfate in rain was negligible because nucleation and scavenging of aerosol were the major processes by which sulfate entered cloud and rain. In Case 2, sulfate concentrations in rain increased by 5-10%. Under environmental conditions of low sulfate aerosol, where oxidation reactions were the dominant means for sulfate to enter cloud and rain, the neglect of sulfate produced by the additional H2O2 may lead to error. The usual uncertainties in the initial SO2 and sulfate aerosol vertical profiles, however, could be a more significant source of error in simulations of the chemistry of cloud and precipitation than the neglect of aqueous-phase peroxide production during the lifetime of even a long-lived system. (Author's abstract)
W91-12252

METAL CONCENTRATIONS IN CRAYFISH TISSUES IN RELATION TO LAKE PH AND METAL CONCENTRATIONS IN WATER AND SEDIMENTS.
Toronto Univ. (Ontario). Dept. of Zoology.
L. Bendell Young, and H. H. Harvey.
Canadian Journal of Zoology CJZOAG, Vol. 69, No. 4, p 1076-1082, April 1991. 1 fig, 10 tab, 45 ref.

Descriptors: *Acid lakes, *Acid rain effects, *Acidification, *Bioaccumulation, *Crayfish, *Lakes, *Metals, *Path of pollutants, Aluminum, Analysis of variance, Barium, Cadmium, Copper, Gills, Iron, Magnesium, Manganese, Statistical analysis, Sulfur, Water pollution effects, Zinc.

The crayfish Cambarus bartoni from two acid lakes, Cambarus robustus from one acid lake, and Orconectes virilis from one acid and two circumneutral lakes were analyzed for the following: Mn, Fe, Al, Zn, Cu, and Cd in gill; Mn, Fe, Al, Zn, and Cu in muscle; and Mn, Al, Fe, Zn, Cu, Ca, Mg, Ba, and S in carapace tissue. Analysis of covariance and canonical variates analysis were used to illustrate differences in the six crayfish populations, based on the elemental content of the three tissues. Gill Cd was significantly greater in all four crayfish populations from the acid lakes, as compared to crayfish from circumneutral lakes. Subsequent canonical variates analysis separated crayfish from acid lakes from those sampled from two circumneutral lakes, based on gill Cd concentrations and to a lesser extent on gill Mn concentrations. Carapace elemental composition was also significantly different among the six crayfish populations, with the canonical variates analysis separating crayfish of acid-lake origin from those captured in circumneutral lakes, based on differences in Mg and Mn content of the carapace; carapaces of crayfish from acid lakes had more Mn and less Mg relative to crayfish carapaces from circumneutral lakes. The elemental composition of crayfish muscle was the least variable and the least indicative of differences in elemental content among the six populations. Conditions of low pH may be preventing the normal mineralization of crayfish carapaces, as evidenced by crayfish from acid lakes having carapaces with lower Mg concentrations relative to crayfish from circumneutral lakes. More importantly, however, increases in gill Cd in crayfish from low-pH lakes appear to be a pH-related effect

rather than being attributable to differences in Cd accumulation among species or to abiotic factors such as concentrations of Cd in the sediments, dissolved organic carbon, or water-borne Ca concentrations. As crayfish are an important food resource for many fish and semiaquatic animals, they could be a key vector in the trophic transfer of Cd from the aquatic to the terrestrial environment. (Author's abstract)
W91-12260

CONTRIBUTION TO THE BIOLOGICAL DESCRIPTION OF RELATIONS BETWEEN SURFACE AND UNDERGROUND WATERS: VULNERABILITY OF AQUIFERS TO RIVER POLLUTION (ESSAI DE DESCRIPTION BIOLOGIQUE DES INTERACTIONS ENTRE EAU DE SURFACE ET EAU SOUTERRAINE: VULNERABILITE D'UN AQUIFERE A LA POLLUTION D'UN FLEUVE).
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Lyon (France). Div. Qualite des Eaux.
M. Lafont, and A. Durbec.
Annales de Limnologie ANLIB3, Vol. 26, No. 2/3, p 119-129, 1990. 4 fig, 2 tab, 22 ref. English summary.

Descriptors: *Groundwater pollution, *Path of pollutants, *Rhone River, *Surface water, *Surface-groundwater relations, Aquifers, Bioindicators, France, Groundwater quality, Oligochaetes, Rivers, Water quality.

A study was conducted to define the vulnerability of phreatic waters to surface water pollution in a strongly polluted site of the Rhone River. Special emphasis was given to the description, by oligochaete communities, of the amplification of water exchanges between surface and underground waters, as well as of the degree of pollution at the site. The coarse sediments/oligochaete index shows low values that attest to a heavy load of industrial pollution. The absolute and relative abundance of taxa such as Phallodrilus sp. increase in superficial coarse substrata in relation to hydraulic measurements of hydric amplification exchanges. These data emphasize the vulnerability of phreatic waters to pollution by superficial waters. Since seasonal effects were not considered, and a new study is planned that will include seasonal factors and data on the biology of subterranean waters. (Author's abstract)
W91-12271

WATER QUALITY: SALINIZATION AND EUTROPHICATION TIME SERIES AND TRENDS IN SOUTH AFRICA.
Water Research Commission, Pretoria (South Africa).
For primary bibliographic entry see Field 5C.
W91-12281

PRELIMINARY INVESTIGATION INTO THE MASS TRANSFER PROPERTIES OF A PESTICIDE ONTO ABIOTIC MEDIA.
Oklahoma State Univ., Stillwater.
Z. Chen, W. F. McTernan, and A. L. Hines.
Journal of Environmental Systems JEVSBH, Vol. 20, No. 2, p 91-109, 1990/1. 5 fig, 7 tab, 24 ref.

Descriptors: *Mass transfer, *Model studies, *Path of pollutants, *Pesticides, *Soil properties, *Soil water, Adsorption, Kinetics, Lipids, Organic matter, Solute transport, Statistical analysis.

The effects of mass transfer properties on pesticide transport through a lab scale soil-water system were evaluated with alternative kinetically based model formulations. External and Internal Resistance as well as Surface Kinetic approaches were employed. Statistical procedures were used in subsequent data analysis to identify model conformance to collected data. The results of the experimental phase of the research indicated that the soil adsorptive capacity increased significantly with the removal of lipids and resins, suggesting that specific types rather than the sum of soil organics affected the adsorption process. While all three models satisfactorily predicted the ultimate capacity, only the Surface Kinetic approach simulated the shape of the breakthrough curves. The low soil organic contents and inherent surface heterogeneities apparently resulted in incomplete coatings of the soil particles and diminished the utility of the External and Internal Resistance Models. These are based upon the assumption of constant adsorptive potentials. The Surface-Kinetic Model effectively addressed this problem. In contrast to traditional adsorption theory, the transfer of an organic solute from liquid to soil may be due to several mechanisms resulting in the adsorption of solute onto the mineral surface as well as a partitioning of adsorbate into the soil humic materials themselves. Further studies on these processes are necessary for a better understanding of the solute transport process in the soil-water system. (Author's abstract)
W91-12286

WATERBORNE OUTBREAK OF NORWALK VIRUS GASTROENTERITIS AT A SOUTHWEST US RESORT: ROLE OF GEOLOGICAL FORMATIONS IN CONTAMINATION OF WELL WATER.
Centers for Disease Control, Atlanta, GA. Div. of Reproductive Health.
For primary bibliographic entry see Field 2F.
W91-12289

WATER SOURCE AS RISK FACTOR FOR HELICOBACTER PYLORI INFECTION IN PERUVIAN CHILDREN.
Children's Nutrition Research Center, Houston, TX.
For primary bibliographic entry see Field 5C.
W91-12290

INTENSIVE 1-MONTH INVESTIGATION OF TRACE METAL DEPOSITION AND THROUGHFALL AT A MOUNTAIN SPRUCE FOREST.
Oak Ridge National Lab., TN. Environmental Sciences Div.
W. H. Petty, and S. E. Lindberg.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 213-226, October 1990. 4 fig, 7 tab, 32 ref. EPRI Integrated Forest Study, RP2621.

Descriptors: *Acid rain, *Forest watersheds, *Heavy metals, *Path of pollutants, *Throughfall, *Trace metals, Air pollution, Cadmium, Dry deposition, Fluctuations, Lead, Manganese, Meteorology, Precipitation, Zinc.

During July 1986, atmospheric concentrations and deposition rates of Pb, Cd, Zn, and Mn were measured at a spruce forest in the Great Smoky Mountains National Park, and meteorological data were recorded. Precipitation, cloud water impaction, and dry deposition were quantified. Average total fluxes of 12, 1.0, 53, and 40 microgm/sq m/d for Pb, Cd, Zn, and Mn, respectively, were measured; dry deposition constituted 46, 32, 62 and 66% of each of the totals. Cloud impaction (unusually low for this particular month) was measurable but not quantitatively important. Dry deposited Pb and Zn were washed from the canopy by subsequent rainfall--revealing greater throughfall fluxes associated with increasing antecedent dry period durations. Cadmium and Mn did not, however, show this relationship. Measurements revealed little interaction of Cd with the forest canopy, while considerable net leaching of Mn was evident (as had been expected). The canopy behaviors of both Pb (i.e., leaching) and Zn (i.e., uptake) were contrary to expections. (Author's abstract)
W91-12292

ACIDIC SNOWMELT EVENT IN A NEW JERSEY STREAM: EVIDENCE OF EFFECTS ON AN INDIGENOUS TROUT POPULATION.
New Jersey Div. of Fish, Game and Wildlife, Lebanon.
For primary bibliographic entry see Field 5C.
W91-12293

SEASONAL VARIABILITY IN THE MERCURY SPECIATION OF ONONDAGA LAKE (NEW YORK).
Brooks Rand Ltd., Seattle, WA.
N. S. Bloom, and S. W. Effler.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 251-265, October 1990. 3 fig, 4 tab, 42 ref.

Descriptors: *Chemical speciation, *Mercury, *Onondaga Lake, *Path of pollutants, *Seasonal variation, *Water chemistry, Environmental chemistry, Lake stratification, Limnology, Mercury compounds, New York, Sulfides.

Dissolved and particulate Hg speciation was determined on four occasions in the Spring to Fall interval of 1989, at three depths of the water column of Onondaga Lake, New York; an urban system in which the sediments and fish flesh are contaminated with Hg. Species determined included total Hg (Hg sub t), reactive (ionic) Hg (Hg sub i), monomethylmercury (CH3HgX), elemental Hg (Hg°) and dimethylmercury ((CH3)2Hg). Onondaga Lake was found to contain very high levels of Hg sub t (2 to 25 ng/L Hg), Hg sub i (0.5 to 10 ng/L Hg), and CH3HgX (0.3 to 7 ng/L Hg), which generally increased with depth in the lake. These concentrations represent a significant level of contamination, based upon comparisons with other polluted and pristine sites. Elemental Hg levels were typically about 0.05 ng/L, and (CH3)2Hg was near the limits of detection (-0.001 ng/L) in most samples. The greatest CH3HgX concentrations in the hypolimnion, as well as the largest gradients of both CH3HgX and Hg sub t were observed upon the first onset of stratification, in early summer. These concentrations did not become more pronounced, however, as stratification and H2S levels in the hypolimnion increased throughout the summer. The very low concentrations of (CH3)2Hg in these MeHg and sulfide-rich waters calls into question the belief that Ch3HgX and H2S will react to yield volatile dimethylmercury, which can then escape to the atmosphere by diffusion. Mercury speciation was highly dynamic, indicating active cycling within the lake, and an apparent sensitivity to changes in attendant limnological conditions that track the stratification cycle. (Author's abstract)
W91-12295

EFFECTS OF WATER CONTENT AND TEMPERATURE ON EQUILIBRIUM DISTRIBUTION OF ORGANIC POLLUTANTS IN UNSATURATED SOIL.
Korea Advanced Inst. of Science and Technology, Seoul (Republic of Korea). Dept. of Civil Engineering.
J. K. Koo, D. W. Ahn, S. P. Yoon, and D. H. Kim.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 267-277, October 1990. 8 fig, 2 tab, 12 ref.

Descriptors: *Organic compounds, *Path of pollutants, *Soil contamination, *Soil water, Distribution patterns, Model studies, Partition coefficient, Soil chemistry, Temperature.

The effects of water content (0.3 to 0.75% for sand, and 0.4 to 1.25% for silt-clay) and temperature (4 to 40 C) on the equilibrium distribution of the priority pollutants, dichloromethane and 1,1,1-trichloroethane in dry Korean decomposed granite soil, were quantified. The values of effective partition coefficient (K-eff) were largely decreased as the water content increased. Organic pollutant partitioning in dry soil is composed of both water saturated and dry sites in sorbent, and a dry site which has a high partition coefficient, is reduced as the water content increases. As the temperature increased, the K-eff values decreased--this effect was magnified at lower water contents. The values of K-eff correlated better with the estimated values using the proposed model. Therefore, in the analysis of distribution and transportation of pollutants in unsaturated soils, the effects of water content and temperature on partitioning need to be considered. (Author's abstract)
W91-12296

COMPARATIVE ASSESSMENT OF THE CHEMICAL AND ADSORPTIVE CHARACTER-

ISTICS OF LEACHATES FROM A MUNICIPAL AND AN INDUSTRIAL LANDFILL.
Southern Methodist Univ., Dallas, TX. Dept. of Civil and Mechanical Engineering.
E. H. Smith, and W. J. Weber.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 279-295, October 1990. 7 fig, 7 tab, 25 ref. NSF Grant CES-8702786 and Kuwait University Research Grant EDV-041.

Descriptors: *Comparison studies, *Landfills, *Leachates, *Municipal wastes, *Path of pollutants, Activated carbon, Adsorption, Chemical properties, Organic carbon, Waste disposal, Waste treatment, Water pollution control.

Leachates from two landfills, one municipal and one industrial, were compared with respect to their chemical and adsorptive characteristics. Concentrations of most inorganic constituents were as much as an order of magnitude higher for the industrial leachate. The concentration of organic matter in that leachate, measured as total organic carbon (TOC), was more than two orders of magnitude greater than that of the municipal leachate. Gel permeation studies suggested similar molecular weight distributions for the organic fractions of the two leachates, but specific priority pollutants identified were different. The adsorptive characteristics of the waste samples with respect to activated carbon were evaluated using TOC as a lumped parameter expression of organic matter concentration. Adsorption equilibria and rates for the municipal leachate system were reasonably well described by treating TOC as a single component for modeling purposes. The industrial leachate required a multicomponent approach. Ideal adsorbed solution theory was used in this case to characterize the behavior of a set of hypothetical TOC components. The approach was able to account, to some degree, for the competitive interactions evident among organic solutes comprising the mixture. (Author's abstract)
W91-12297

SUBSURFACE LEACHATE MIGRATION FROM A REJECT COAL PILE IN SOUTH CAROLINA.
Savannah River Ecology Lab., Aiken, SC. Div. of Biogeochemical Ecology.
C. A. Carlson.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 345-366, October 1990. 7 fig, 5 tab, 18 ref. DOE Contract No. DE-AC09-76SROO-819.

Descriptors: *Coal mine wastes, *Leachates, *Path of pollutants, *South Carolina, *Vegetation effects, *Waste disposal, Acid mine water, Aquifers, Coal mining effects, Environmental effects, Groundwater movement, Groundwater pollution, Hydrogen ion concentration, Root zone, Savannah River, Water table, Wetlands.

Transport of contaminants from coal storage areas through the rooting zone has the potential to negatively affect shallow groundwater and terrestrial vegetation. Reject coal piles represent a worst-case scenario for contamination from coal storage areas because of the long residence time of the coal. Preliminary hydrologic data were collected from an area of stressed vegetation adjacent to an inactive ash basin and reject coal pile in South Carolina. The water table is near the surface (< 60 cm) in this wetland area and water movement is primarily to the west, toward the Savannah River. Acid leachate migration from the reject coal pile has contaminated the water table aquifer with sulfate (up to 22,200 mg/L) and metals (Fe to 9560 mg/L, Al to 1110 mg/L). A shallow plume of contaminated groundwater parallels the reject coal pile, is elongated in the direction of groundwater movement, and is migrating westward at a calculated velocity range of 6.3 to 10.4 m/yr. Leachate migration from the reject coal has produced a highly acidic (pH down to 2.2) and highly saline (Ec to 11.8 dS/m) rooting zone and is most likely responsible for the stressed vegetation in the study area. (Author's abstract)
W91-12300

MULTIVARIATE TESTS FOR TREND IN WATER QUALITY.
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5G.
W91-12319

EFFICIENT AND ACCURATE FRONT TRACKING FOR TWO-DIMENSIONAL GROUNDWATER FLOW MODELS.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
A. L. Shafer-Perini, and J. L. Wilson.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1471-1485, July 1991. 18 fig, 3 tab, 22 ref. DOE Contract DE-AC03-85BC-10850 and USGS Grant 14-08-0001-G-1632.

Descriptors: *Aquifer remediation, *Groundwater movement, *Model studies, *Path of pollutants, *Remediation, Algorithms, Aquifers, Flow profiles, Mathematical studies, Wells.

Four new algorithms were developed which cost-effectively delineate displacement fronts and capture zones via particle tracking in complex flow fields. These algorithms include methods of: (1) defining path lines using 'mixed distance and time particle tracking'; (2) computing displacement fronts and capture zones using 'dynamic particle allocation front tracking,' allowing insertion/deletion of particles to optimize front definition; (3) obtaining accurate breakthrough curve by using simultaneous 'mass redistribution,' reallocating particle mass among particles defining the displacement front; and (4) determining production well breakthrough curves using 'optimized sorting algorithms; when backward tracking to map capture zones. Examples are shown for capture zones and aquifer remediation applications, with comparisons made to conventional algorithms. Results show that the number of particles required to define displacement fronts and breakthrough curve is a function of time, position, and flow field complexity. Dynamic front tracking resulted in a significant savings of storage and computational expense, even for relatively simple velocity fields. A corresponding increase in the accuracy of breakthrough curves was obtained. (Author's abstract)
W91-12324

ONE-DIMENSIONAL SUBSURFACE TRANSPORT OF A NONAQUEOUS PHASE LIQUID CONTAINING SPARINGLY WATER SOLUBLE ORGANICS: A FRONT-TRACKING MODEL.
California Univ., Los Angeles. Dept. of Chemical Engineering.
P. A. Ryan, and Y. Cohen.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1487-1500, July 1991. 7 fig, 6 tab, 33 ref, 2 append. EPA Grant CR-8127711.

Descriptors: *Groundwater movement, *Model studies, *Multiphase transport, *Nonaqueous phase liquids, *Organic compounds, *Path of pollutants, Algorithms, Froude number, Mathematical studies, Reynolds number, Solute transport.

A one-dimensional multiphase mass transport model was developed for the migration of a nonaqueous phase liquid (NAPL) containing water soluble organics in the unsaturated soil zone. The multiphase NAPL transport (MUNT) model consists of a two-phase immiscible flow model linked to a four-phase chemical transport model. The immiscible flow model incorporates a front-tracking algorithm to determine the front of the invading NAPL as a function of penetration time. The NAPL penetration toward groundwater is shown to be a function of four dimensionless groups: NAPL capillary number, the ratio of the NAPL Reynolds number to the NAPL Froude number, and the ratio of the defending phase to NAPL phase densities and viscosities. Simulation for the migration of organic chemicals showed that their concentration in the air and aqueous phases past the front can be significant. (Author's abstract)
W91-12325

HYSTERESIS AND STATE-DEPENDENT ANISOTROPY IN MODELING UNSATURATED HILLSLOPE HYDROLOGIC PROCESSES.
Washington State Univ., Pullman. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-12326

EMERALD LAKE WATERSHED STUDY: INTRODUCTION AND SITE DESCRIPTION.
California State Air Resources Board, Sacramento. Research Div.
K. A. Tonnessen.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1537-1539, July 1991. 1 fig, 22 ref.

Descriptors: *Acid rain, *Acid rain effects, *California, *Emerald Lake Watershed, *Sierra Nevada, *Water pollution effects, Acidification, Bicarbonates, Buffer capacity, Calcium, Ecosystems, Geohydrology, Hydrogen ion concentration, Hydrologic budget, Kaweah River, Marble Fork River, Mountain watersheds, Precipitation, Runoff, Seasonal variation, Snowmelt, Wildlife.

The Emerald Lake Watershed study was organized to investigate the effects of acidic deposition on high-elevation watersheds and surface waters of the Sierra Nevada, California. Some of the results of this comprehensive study of aquatic and terrestrial ecosystems at a small, headwater basin are presented in four papers in this series. The watershed study site is in Sequoia National Park, on the western slope of the Sierra Nevada. This glacial cirque is located in the upper Marble Fork of the western slope of the Kaweah River--a 120-ha watershed which ranges from Alta Peak (3416 m) down to Emerald Lake (2400 m). Most of the watershed surface area is exposed granite and granodiorite rocks, with limited coverage (about 20%) by thin, acidic soils. The hydrology of the basin is dominated by snowmelt runoff during March-June. Emerald Lake, a glacial tarn, is 2.72 ha in area, with a maximum depth of 10.5 m. Surface waters are poorly buffered and dominated by calcium and bicarbonate. Most of the yearly precipitation falls as dilute snow (pH 5.2-5.4), with acidic rain storms sampled during May-October. (See W91-12330 thru W91-12333) (Author's abstract)
W91-12329

PRECIPITATION CHEMISTRY IN AND IONIC LOADING TO AN ALPINE BASIN, SIERRA NEVADA.
California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
For primary bibliographic entry see Field 2B.
W91-12332

SOLUTE CHEMISTRY OF SNOWMELT AND RUNOFF IN AN ALPINE BASIN, SIERRA NEVADA.
California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
M. W. Williams, and J. M. Melack.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1575-1588, July 1991. 14 fig, 2 tab, 42 ref. California Air Resources Board Contract Nos. A3-103-32, A6-147-32, and A3-096-32.

Descriptors: *Acid rain, *California, *Chemistry of precipitation, *Emerald Lake, *Environmental chemistry, *Mountain watersheds, *Runoff, *Sierra Nevada, *Snowmelt, *Streamflow, Acid neutralizing capacity, Alpine regions, Ammonium, Chlorides, Hydrochemistry, Hydrogen ion concentration, Ions, Nitrates, Particulates, Sulfates.

Snowpack runoff contributions to the hydrochemistry of an alpine catchment in the Sierra Nevada were evaluated in 1986 and 1987 by analyzing snowpack, meltwater, and stream water samples for major inorganic ions, conductance, acid neutralizing capacity (ANC), and silicate. An ionic pulse in meltwater with initial concentrations two-fold to twelve-fold greater than the snowpack average, varying with site and with ion, was measured in lysimeters placed at the base of the snowpack. Maximum concentrations of ions in meltwater were inversely related to the rate of snowmelt; melt-freeze cycles increased the concen-

tration of solutes in meltwater. Hydrogen concentration in meltwater was buffered by ANC produced in part by the dissolution of particulates. The anionic pulse in meltwater was observed in stream waters during the first 30 days of snowpack runoff, with NO3(-) concentrations in stream waters at this time about 1.6-fold greater than average NO3(-) concentration for the time period of snowpack runoff Cl(-) about 1.5-fold greater and SO4(2-) about 1.3-fold greater. Maximum H(+) concentration during snowpack runoff (increase of 170% over winter concentrations) occurred near maximum discharge. ANC minima occurred at maximum discharge as a result of dilution, with a decrease from winter concentrations of 70% in 1986 and 60% in 1987. Interactions between snowpack runoff and soils were important to the chemistry of stream water. Eighty to ninety percent of the H(+) stored in the snowpack was consumed before it reached the base of the catchment. Soils were a sink for NH4(+) from snowpack meltwater, with M 1% of the NH4(+) released from snowpack storage exported from the basin as NH4(+). Sulfate concentrations in stream waters were less variable than NO3(-) or Cl(-) concentrations; sorption processes in soils were a likely cause for the regulation of SO4(2-) concentrations. (See W91-12329) (Author's abstract)
W91-12333

STATISTICAL ESTIMATION AND INTERPRETATION OF TRENDS IN WATER QUALITY TIME SERIES.
Lund Univ. (Sweden). Dept. of Mathematical Statistics.
For primary bibliographic entry see Field 5G.
W91-12338

TRANSPORT IN HETEROGENEOUS POROUS MEDIA: PREDICTION AND UNCERTAINTY.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-12347

BACTERIA AS A SOURCE OF PHOSPHORUS FOR ZOOPLANKTON.
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2H.
W91-12383

PHOSPHORUS AND NITROGEN DYNAMICS IN STREAMS DURING A WILDFIRE.
Montana Univ., Polson. Flathead Lake Biological Station.
For primary bibliographic entry see Field 2E.
W91-12397

NUTRIENT CYCLING BY BIOFILMS IN RUNNING WATERS OF DIFFERING NUTRIENT STATUS.
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2E.
W91-12398

DEGRADATION OF HALOGENATED PHENOLS IN ANOXIC NATURAL MARINE SEDIMENTS.
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
K. Abrahamsson, and S. Klick.
Marine Pollution Bulletin MPNBAZ, Vol. 22, No. 5, p 227-233, May 1991. 4 fig, 28 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Halogenated compounds, *Marine sediments, *Path of pollutants, *Phenols, Bromophenols, Chlorophenols, Dehalogenation, Microbial degradation.

Halogenated phenols were added to three anoxic marine sediment samples which were incubated under different conditions. The concentrations of the halogenated phenols were monitored throughout the experiment in order to study their degradation. The results were: (1) the main degradation pathway was progressive dehalogenation. The dehalogenation order was ortho > para > meta; (2) between 6 C and 30 C the dehalogenation rate increased for all substances, while a further increase in temperature resulted in a decrease of dehalogenation rate; (3) bromophenols were degraded faster than chlorophenols; (4) sediment which had been exposed to effluent water from a paper and pulp mill showed a higher dehalogenation potential; and (5) the results indicate that microorganisms associated to particles are responsible for the dehalogenation. (Author's abstract)
W91-12402

HEAVY METALS IN THE POLYCHAETE LYCASTIS OUANARYENSIS FROM THANE CREEK, INDIA.
Department of Zoology, B. N. Bandodkar Coll., Thane (W), 400 601, India.
R. P. Athalye, and K. S. Gokhale.
Marine Pollution Bulletin MPNBAZ, Vol. 22, No. 5, p 233-236, May 1991. 3 fig, 2 tab, 7 ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Polychaetes, *Thane Creek, Bioavailability, Cadmium, Copper, India, Lead, Nutrients, Organic compounds, Salinity, Zinc.

A polychaete Lycastis ouanaryensis inhabiting soft sediment in Thane Creek (India) was investigated for Zn, Cu, Pb and Cd content from two stations having more or less similar physicochemical parameters except organic pollution. The study revealed more regulation of metals in polychaetes from the stations severely polluted with organics. This ability was attributed to either the reduced bioavailability of metals due to organic enrichment or to the higher nutritional status. Seasonal changes in body metals showed high metal levels during periods of population decline, probably caused by salinity stress. (Author's abstract)
W91-12403

MULTIVARIATE ANALYSIS OF ORGANOCHLORINES IN RED MULLET FROM GREEK WATERS.
National Centre for Marine Research, Athens (Greece).
E. Georgakopoulos-Gregoriades, V. Vassilopoulou, and K. I. Stergiou.
Marine Pollution Bulletin MPNBAZ, Vol. 22, No. 5, p 237-241, May 1991. 4 fig, 2 tab, 31 ref.

Descriptors: *Bioaccumulation, *Greece, *Multivariate analysis, *Organochlorines, *Path of pollutants, Aegean Sea, Aroclors, Chlorinated hydrocarbons, DDE, DDT, Lipids, Mullet, Pagasitikos Gulf, Pilchard, Polychlorinated biphenyls, Statistical analysis.

Organochlorine concentrations were examined in the flesh of red mullet collected at 8 locations in Greek waters. Cluster analysis and ordination techniques revealed three groups of sites: (1) the Aegean Sea, characterized by an almost uniform distribution of polychlorinated biphenyls (PCBs) and relatively high DDTs; (2) the western Greek waters, characterized by low organochlorine concentrations; and (3) Pagasitikos Gulf (a shallow, enclosed basin receiving the outflow of urban and heavy industrial wastes) characterized by the higher concentrations of chlorinated biphenyls. The compounds found in greatest concentrations were, among PCBS, Aroclor 1254 and, among DDTs, p,p' DDE. PCBs and DDTs concentrations in the flesh of red mullet in Pagasitikos Gulf exhibited a seasonal cycle with a minimum in June, when mass spawning of red mullet takes place. Feeding intensity of red mullet, and hence lipid concentration, declines sharply during spawning. These facts possibly imply that low PCBs and DDTs concentrations are related to low lipid concentrations. Such a positive relation between lipids and chlorinated hydrocarbons is consistent with the results of other studies. The DDTs and PCBs concentrations in the flesh of red mullet were also compared with those of pilchard; comparisons are referred to specimens of similar length, collected at the same area/season. Red mullet and pilchard belong to the same trophic level, the former feeding mainly on benthic invertebrates, the latter on zooplankton. Since marine sediments are rich in organochlorines due to the vertical settlement of feces rich in organic residues, one would expect higher concentrations of organochlorinates in the flesh of a benthic predator. However, the concentrations of PCBs and DDTs are higher in pilchard. The different mechanisms of lipid accumulation and concentration in these species result to higher lipid content in sardine as compared to red mullet. This combined with the higher organochlorine concentrations found in the flesh of pilchard, corroborate the view that lipids and organochlorine compounds are positively related. (Lantz-PTT)
W91-12404

DISSOLVED AND PARTICULATE TRACE METALS IN SURFACE WATERS OVER THE DOGGER BANK, CENTRAL NORTH SEA.
Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab.
C. F. Fileman, N. Althaus, R. J. Law, and I. Haslam.
Marine Pollution Bulletin MPNBAZ, Vol. 22, No. 5, p 241-244, May 1991. 1 fig, 3 tab, 22 ref.

Descriptors: *Chemical analysis, *Dogger Bank, *Marine environment, *North Sea, *Path of pollutants, *Pollutant identification, *Surface water, *Trace metals, Atomic absorption spectrophotometry, Cadmium, Cobalt, Copper, Filtration, Heavy metals, Iron, Lead, Manganese, Mercury, Nickel, Suspended solids, Zinc.

Samples of surface water were collected from 14 stations over the southern Dogger Bank and the Outer Silver Pit in November 1989. Analyses were carried out for dissolved Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb by solvent extraction followed by graphite furnace atomic absorption spectrophotometry (GFAAS), and for Hg (total and reactive) by cold vapor AAS (CVAAS). Samples of suspended particulate material, isolated by filtration were analyzed for Al, Cr, Ni, Cu, Zn, Cd, and Pb by GFAAS following digestion with hydrofluoric acid, and for Hg by atomic fluorescence following digestion with concentrated nitric and hydrochloric acids. Concentrations of dissolved trace metals were in good agreement with those reported previously for the Central North Sea (Mn, Co, Ni, Cu, Cd) and offshore waters (Pb, Hg). The concentrations of trace metals in suspended particulate material were similar to, or lower than, those reported by other workers. Elevated concentrations of some trace metals were seen in both phases following a storm. (Author's abstract)
W91-12405

SURVEY OF SHORELINE LITTER IN HALIFAX HARBOUR 1989.
Dalhousie Univ., Halifax (Nova Scotia). School for Resource and Environmental Studies.
J. B. Ross, R. Parker, and M. Strickland.
Marine Pollution Bulletin MPNBAZ, Vol. 22, No. 5, p 245-248, May 1991. 3 fig, 1 tab, 24 ref.

Descriptors: *Detritus, *Halifax Harbor, *Marine environment, *Shores, *Surveys, *Urbanization, *Water pollution sources, Nova Scotia, Public participation, Public policy, Recreation, Waste disposal.

The problem of marine litter has gained increased public attention over the past decade and has spawned numerous efforts to deal with it. The litter problem in Halifax Harbor is created mainly by the citizens of the area rather than by industry, the military, or other sources. The litter in the harbor, from recreational and land-based sources, accounted or 62% of the total litter found. The major impact of this litter is its negative aesthetic effect, i.e. the fouling of shorelines and beaches with unsightly garbage. All of the litter appeared to originate within the harbor area itself. No litter was positively identified as having washed into the harbor from the open sea. Heavy materials, such as wood and metal, accumulated on high energy beaches; plastic styrofoam, and larger amounts of all litter types were accumulated mainly on low energy sand or pebble beaches. Plastic represented the most common material comprising 54% of the

total. A primary treatment plant proposed for Halifax and Dartmouth should reduce shoreline litter by about 20%. An education program directed at the general public would be an important and effective method of dealing with this problem. In combination with strict enforcement of the recently drafted Litter Abatement Act, improved garbage management at public beaches, boat ramps and marinas, and sewage treatment could eliminate about 82% of the shoreline litter in Halifax Harbor. (Lantz-PTT)
W91-12406

METALS IN MYTILUS EDULIS FROM THE NORTHERN COAST OF PORTUGAL.
Porto Univ. (Portugal). Dept. de Fisiologia.
J. Coimbra, S. Carraca, and A. Ferreira.
Marine Pollution Bulletin MPNBAZ, Vol. 22, No. 5, p 249-253, May 1991. 4 fig, 5 tab, 34 ref.

Descriptors: *Bioaccumulation, *Coastal waters, *Heavy metals, *Mussels, *Path of pollutants, *Portugal, Cadmium, Copper, Growth stages, Iron, Salinity, Seasonal variation, Tissue analysis, Water pollution sources, Zinc.

Porto, on the northern coast of Portugal, has a population of half a million and is situated on the Douro estuary. Health authorities are concerned with industrial and urban refuse dumps. This study was carried out to determine metal concentrations in the area, using mussels as indicators. Five sites were chosen around Port, and mussel samples were analyzed for Fe, Zn, Cu, and Cd. Samples of Mytilus edulis were collected from an intertidal band on the rocky shore at low tide from five beaches: Povoa de Varzim, Vila Chap, Cabo do Mundo, Lavadores and Aguda. Analyses was carried out by flame atomic absorption spectrophotometry. A large variation was found between minimum and maximum values for the concentration of each metal, indicating a strong annual variation. To study this variation in mussels throughout the year, two locations were chosen, one situated at the north of Douro and Leca rivers estuaries (Vila Chap) and the other at the south of their mouth (Aguda), where sampling was made monthly or every two weeks. April, was one of the months when sampling was made in all the five sites. The results clearly show that for all the metals, the concentrations found in April are higher than the mean in almost all the locations. For Fe, the lowest values were found near Porto and Povoa de Varzim. Mussels from the same sites gave higher values for Cu. High values for Zn and Cd were found in the mussels collected between Vila Chap and Lavadores while Povoa de Varzim and Aguda samples gave lower values. Exogenous factors such as changes in salinity in coastal area through the year depending on rainfall and river freshwater input, contribute to seasonal variation. Decreased salinities were found to increase the net uptake of cadmium and copper by this organism, but to decrease that of lead. However, endogenous factors must also be involved, one of the most important being the effect of the reproductive cycle on metal accumulation. Lower values found for Fe at stations near the Douro/Leca and Ave estuaries, where salinity is low probably indicates a dilution effect. (Lantz-PTT)
W91-12407

VERTICAL PROFILES OF COPPER IN SEDIMENTS FROM THE FLY DELTA AND GULF OF PAPUA (PAPUA NEW GUINEA).
Australian Inst. of Marine Sciences, Townsville.
D. M. Alongi, F. Tirendi, and A. I. Robertson.
Marine Pollution Bulletin MPNBAZ, Vol. 22, No. 5, p 253-255, May 1991. 2 fig, 1 tab, 10 ref.

Descriptors: *Copper, *Fly River, *Gulf of Papua, *Fly Delta, *River sediments, *Sediment contamination, *Water pollution sources, Chemical analysis, New Guinea, Path of pollutants.

The Fly River, located at the southwestern corner of Papua New Guinea, is approximately the tenth largest tropical river in the world, proving nearly 238 cu km of freshwater and 74 million tons of suspended sediments annually into the adjacent Gulf of Papua. Since 1984, a large copper and gold mine has been operating on the Ok Tedi, an upper tributary of the Fly, and has been depositing increasing amounts of suspended mining effluents into the Fly catchment area. This enormous tailings burden, coupled with very high rates of annual precipitation (up to 13 m/yr at the headwaters of the rivers), suggest the potential for metal pollution, particularly copper, within the river delta and adjacent Gulf of Papua and Torres Strait. Sediment samples (20 cm maximum depth) were collected at 14 locations during July-August 1989 and February 1990. Trends in particulate Cu levels with sediment depth were not consistent among stations. For most stations, particularly in the Gulf of Papua, Cu levels did not change with depth. Two stations in the southern channel stations in the Gulf of Papua (7-29 microgm/gm DW). Particulate Cu concentrations correlated significantly only with sedimentary organic carbon and total nitrogen concentrations. Dissolved Cu concentrations in the porewaters and in bottom waters were consistently less than, or at the detection limit, and were probably within the range detected for pelagic waters in the northern Torres Strait. Fluxes of dissolved Cu across the sediment-water interface were detected only at stations D4 and D5 and were low (-6 and 6 mg/sq m/d, respectively) indicating that diagenesis of deposited Cu was minor. It was concluded that the present Cu levels (as of July-August 1989 and February 1990) found at most stations in the vicinity of the Fly estuary are not necessarily abnormal. (Lantz-PTT)
W91-12408

STUDIES IN BATCH AND CONTINUOUS SOLVENT SUBLATION. III. SOLUBILITY OF PENTACHLOROPHENOL IN ALCOHOL-WATER MIXTURES AND ITS EFFECTS ON SOLVENT SUBLATION.
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
K. T. Valsaraj, L. J. Thibodeaux, and X. Y. Lu.
Separation Science and Technology SSTEDS, Vol. 26, No. 4, p 529-538, April 1991. 4 fig, 2 tab, 23 ref. NSF Grant BAC-8822835.

Descriptors: *Cleanup, *Path of pollutants, *Pentachlorophenol, *Solubility, *Solvents, *Wastewater treatment, Chemical analysis, Margules equation, Mathematical studies, Organic compounds, Physicochemical properties, UNIFAC model.

Pentachlorophenol (PCP) is often used as a fungicide and is a significant soil and water contaminant near wood-preservation sites. The behavior of PCP with respect to different processes for removal from the aqueous phase by way of adsorption on solid phases, liquid-liquid extraction, solvent sublation, and foam flotation has been the focus of several investigations. The solubility of PCP in pure water and alcohol-water mixtures at pH 2.5 and 5.0 at 25 C, were determined in this study by using the two-suffix Margules equation and the UNIFAC model. The effect of alcohols on the PCP solubility follows closely the predictions of the two-suffix Margules equation, however, the Margules equation will not be applicable to ionic systems such as phenolate ions at pH 5.0. UNIFAC predicts an infinite dilution activity coefficient of -0.000000013 which yields a mole fraction solubility for PCP in pure water of 0.000000017. These results indicate that UNIFAC underpredicts the PCP solubility in water. (Lantz-PTT)
W91-12409

CADMIUM UPTAKE FROM CADMIUM-SPIKED SEDIMENTS BY FOUR FRESHWATER INVERTEBRATES.
Guelph Univ. (Ontario). Dept. of Zoology.
B. W. Kilgour.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 70-75, July 1991. 2 tab, 17 ref.

Descriptors: *Bioaccumulation, *Cadmium, *Heavy metals, *Invertebrates, *Path of pollutants, *Sediment contamination, Animal behavior, Bioassay, Cox Creek, Crustacea, Mollusks, Ontario, Pollutant identification, Tissue analysis.

In studies of metal-contaminated fresh waters and sediments, the unionid bivalve Elliptio complanata commonly is used as a bioaccumulator. An attempt was made to identify other organisms that may be useful in assessing the pollution status of freshwater sediments. Cadmium concentrations of four common benthic organisms exposed to cadmium-spiked sediments were examined (Sphaerium striatinum (deposit feeder and filter feeding clam; burrower), Hyalalla azteca (grazing and deposit feeding amphipod; non-burrower), Physella gyrina (grazing amphipod; non-burrower), and Stichtochironomus cf. flavicingula (deposit feeding chironomid; burrower)). The organisms were collected in Cox Creek (Waterloo County, Ontario) and were exposed to each of five concentrations of cadmium-spiked sediments for 10 days at 21 C under natural photoperiod, beginning on July 8, 1988. Differences in body concentrations among the four species in treatments with cadmium added suggest that orientation to sediments, behavior, and physiology were important in determining body concentrations. In the treatment with the highest cadmium levels, S. flavicingula and P. gyrina had the highest body concentrations, indicating a greater ability to accumulate cadmium than the other two species. The data indicate that the body concentrations of the burrowing species are more predictable than those of the non-burrowing species and that water-cadmium concentrations are important to body concentrations in the two molluscs. S. flavicingula and S. striatinum had the most predictable body concentrations. Cadmium concentrations in individuals of these species may, therefore, be more useful for predicting environmental concentrations of cadmium. (Rochester-PTT)
W91-12433

EFFECT OF PH AND TEMPERATURE ON THE UPTAKE OF CADMIUM BY LEMNA MINOR L.
Industrial Toxicology Research Centre, Lucknow (India). Ecotoxicology Section.
G. Chawla, J. Singh, and P. N. Viswanathan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 84-90, July 1991. 3 tab, 19 ref.

Descriptors: *Aquatic plants, *Bioaccumulation, *Cadmium, *Path of pollutants, *Temperature effects, *Toxicology, Duckweed, Hydrogen ion concentration, Plant growth, Plant physiology, Temperature.

Many aquatic macrophytes can accumulate heavy metals from polluted water. An attempt was made to determine the optimal conditions for metal bioconcentration by Lemna minor in relation to pH and temperature. Plants were grown in 250 ml flasks modified Hoagland's medium. The uptake and tissue content of Cd in Lemna varied with Cd exposure in terms of time, pH, and temperature. Maximum concentration were found in the trichloroacetic acid-insoluble form at 96 hr at pH 7.5 and 0.5 ppm and the highest in TCA-soluble fraction at 96 hr at pH 6.5 and 0.5 ppm Cd. The uptake was greater after the first 48 hr, probably due to a lapse in the initial ionic uptake, which later was influenced by decreased metabolic activity as toxicity set in. It seems likely that plants growing at pH 7.5 are better able to form Cd-binding proteins as an effort to counteract pH stress. At pH 6.5, where Cd could be in ionic form, the uptake was more enhanced by prolonged exposure than at the other two pH values. At pH 7.5 there was a preferential increase in protein-bound form and at pH 6.5 in the free form. It is apparent that as a result of pH stress Cd uptake and sequestration mechanisms were altered. The decrease due to high pH was more evident at 30 C than at 20 C, possibly due to higher solubility. The low concentration build-up observed at 10 C could have been due to cold stress. At the optimal temperature of 20 C, the effect of pH was less prominent. Apparently, at the optimal conditions of plant growth, there is better uptake and sequestration until the lesions of toxicity develop. (Rochester-PTT)
W91-12435

COMPARATIVE STUDY OF CADMIUM AND LEAD ACCUMULATIONS IN CAMBARUS BARTONI (FAB.) (DECAPODA, CRUSTACEA) FROM AN ACIDIC AND A NEUTRAL LAKE.
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
S. Keenan, and M. A. Alikhan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 91-96, July 1991. 2 fig, 2 tab, 16 ref.

Descriptors: *Acid lakes, *Bioaccumulation, *Cadmium, *Crayfish, *Industrial wastes, *Lead, *Ontario, *Path of pollutants, Alkalinity, Hydrogen ion concentration, Nepahwin Lake, Smelters, Tissue analysis, Water pollution effects, Wavy Lake.

Many natural waters in Ontario are contaminated with various heavy metals as a result of pollution from smelters. A study was conducted to compare the concentrations of lead and cadmium in the sediment and water, as well as in the crayfish Cambarus bartoni (Fab.) (Decapoda: Crustacea) trapped from an acidic and a neutral lake in the Sudbury district of northeastern Ontario. Hepatopancreatic, alimentary canal, tail muscle, and exoskeletal tissues were examined for accumulation of these metals. Animals were trapped in October 1989 from Nepahwin Lake (pH 6.5 +/-0.4, alkalinity, 9.93 +/-0.38) and Wavy Lake (pH 4.6 +/-0.3, alkalinity 1.08 +/-0.05). Nepahwin Lake had traces of Cd in the water and 21.43 +/-6.24 ppb in the sediments; lead was 0.24 +/-0.04 ppb in the water and 196.11 +/-1.88 ppb in the sediments). The respective figures for Cd in Wavy Lake were 4.78 +/-0.33 and not determined; for lead the figures were 0.32 +/-0.04 ppb and 110.11 +/-1.04 ppb. Despite the significant differences in Cd and Pb concentrations in the sediments of these two lakes, the crayfish trapped in them did not differ significantly ($p > 0.05$) between in their Cd concentrations. Lead concentrations, on the other hand, ranged from 72.5 to 74.9 microgram/g wet weight in decapods trapped in Nepahwin Lake and 94.8 to 106.6 microgram/g wet weight in those obtained in Wavy Lake. The general relationship in Cd and Pb concentrations in the four tissues of the crayfish from both sites was hepatopancreas > alimentary canal > exoskeleton > tail muscles. Differences in metal concentrations between males and females at the site were not significant. (Rochester-PTT)
W91-12436

BENSULFURON METHYL DISSIPATION IN CALIFORNIA RICE FIELDS, AND RESIDUE LEVELS IN AGRICULTURAL DRAINS AND THE SACRAMENTO RIVER.
California Dept. of Food and Agriculture, Sacramento.
S. Nicosia, C. Collison, and P. Lee.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 131-137, July 1991. 3 fig, 1 tab, 6 ref.

Descriptors: *Bensulfuron methyl, *Herbicides, *Path of pollutants, *Rice fields, *Sacramento River, *Water pollution sources, Agricultural chemicals, Agricultural runoff, California, Pesticide residues.

Herbicides applied to rice fields in the Sacramento Valley, California, are released into agricultural drains via runoff water. Bensulfuron methyl (BSM: Londax; methyl 2-((((((4,6-dimethoxypyrimidin-2-yl)amino)carbonyl)amino)sulfonyl)methyl)benzoate)) was registered in 1989 in California as a rice herbicide. The dissipation of BSM from paddy water of commercial rice fields was examined and residue levels in major agricultural drains the Sacramento River were examined. On application day, the expected initial concentrations of BSM were 37, 77, and 65 microgram (ug)/L. Approximately 5 hr after application, average measured concentrations were 29 ug/L, 96 ug/L, and 71 ug/L. BSM concentration declined exponentially in the paddy water of the three fields. Although BSM was applied at low rates and has a short dissipation half-life in paddy water, low-level residues were detected in major agricultural drains for as long as a month. The presence of residues in agricultural drains for this length of time indicates the potential of rice runoff water to affect the quality of the aquatic environment. (Rochester-PTT)
W91-12437

SURVEY OF FARM WELLS FOR NUTRIENTS AND MINERALS, ONTARIO, CANADA, 1986 AND 1987.
Ontario Ministry of Agriculture and Food, Guelph. Agricultural Lab. Services Branch.
For primary bibliographic entry see Field 5F.
W91-12438

DISTRIBUTION OF MERCURY IN THE SEDIMENTS OF EIGHT SASKATCHEWAN LAKES.
Saskatchewan Univ., Saskatoon. Dept. of Biology.
A. T. Merkowsky, U. T. Hammer, and P. M. Huang.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 75, No. 4, p 551-559, 1990. 3 fig, 3 tab, 27 ref. Natural Science and Engineering Research Council of Canada Strategic Grant G1994.

Descriptors: *Lake sediments, *Mercury, *Path of pollutants, *Saskatchewan, Bioaccumulation, Buffalo Pound Lake, Katepwa Lake, Saskatchewan River, Tissue analysis, Walleyes.

Mercury was discovered in fish in the North and South Saskatchewan River in the 1970s. Since this discovery, investigations have been conducted to determine the levels of mercury in aquatic ecosystems in the province. Eight lakes located in the southern half of Saskatchewan were sampled in May and June, 1987, to determine the concentration and spatial distribution of mercury in their surface sediments. Katepwa and Buffalo Pound lakes had maximum total mercury concentrations in sediment of 0.158 and 0.100 microgram/gram dry weight, respectively, whereas in the other six lakes the mercury concentration never exceeded 0.04 microgram/gram dry weight. Despite this difference in mercury concentration in the sediments of the lakes, walleye sampled from them have high mercury concentrations exceeding 0.5 microgram/gram (wet weight). (Author's abstract)
W91-12449

ANALYTICAL METHOD TO DETERMINE HENRY'S LAW CONSTANT FOR SELECTED VOLATILE ORGANIC COMPOUNDS AT CONCENTRATIONS AND TEMPERATURES CORRESPONDING TO TAP WATER USE.
Harvard School of Public Health, Boston, MA. Dept. of Environmental Health Sciences.
M. V. Tancrede, and Y. Yanagisawa.
Journal of the Air & Waste Management Association JAWAEB, Vol. 40, No. 12, p 1658-1663, December 1990. 2 fig, 3 tab, 29 ref, 2 append.

Descriptors: *Air pollution sources, *Analytical methods, *Domestic water, *Henrys Law, *Path of pollutants, *Volatile organic compounds, Drinking water, Gas chromatography, Laboratory methods, Temperature, Water analysis.

Henry's Law constants (Hs) are needed to model human exposure to volatile organic compounds (VOCs) in indoor air resulting from the use of tap water. An experimental method was developed to determine Hs for several common tap water pollutants at concentrations and temperatures used in household water. Hs were obtained simultaneously for five VOCs (chloroform, carbon tetrachloride, trichloroethylene, 1,2,3-trichloropropane, and tetrachloroethylene) over the 25-45 C temperature range, providing data on H behind the currently available data (to 35 C). Hs were obtained as the ratio of equilibrium concentrations of VOCs in air and water, using simultaneous sampling from sealed bottles kept at constant temperatures. Air and water samples were concentrated by a purge-and trap method, thermally desorbed from a Tenex trap, and analyzed with a gas chromatograph with an electron capture detector. Experimental results agreed well with available literature data. (Author's abstract)
W91-12452

HYDROGEOLOGICAL AND ENVIRONMENTAL IMPACT OF COAL MINING, JHARIA COALFIELD, INDIA.
Indian School of Mines, Dhanbad. Dept. of Applied Geology.
For primary bibliographic entry see Field 4C.
W91-12463

PLUTONIUM IN SEDIMENTS--APPARENT HALF-LIVES.
Stockholm Univ. (Sweden). Dept. of Geology.
P. Ostlund, and R. O. Hallberg.
Environmental Geology and Water Sciences EGWSEI, Vol. 17, No. 3, p 195-200, May/June 1991. 8 fig, 23 ref.

Descriptors: *Chemical interactions, *Fate of pollutants, *Model studies, *Path of pollutants, *Plutonium, *Radioactive half-life, *Sediment contamination, Baltic Sea, Kinetics, Risk assessment, Sediment-water interfaces, Vertical distribution.

One of the primary objectives in environmental radioactivity research is to clarify pathways from source to man and thereby limit risks for exposure. Nuclides discharged into water systems are scavenged to varying degrees in the water mass and deposited on the sediment surface. In shallow water sediments, the eventual direct exposure of humans to radioactive substances takes place over the sediment-water interface. A simple plutonium risk assessment model has been developed to predict the duration of hazardous substances in sediments based on apparent half-lives. The model is designed for a pulse bulk input to shallow-water sediments. The model is based on the hypothesis that the reduction of plutonium activities from sediment surfaces can be approximated as first-order reactions. A total of six sediments from the Baltic Sea, all representing shallow water areas, were chosen for the study. The combined activities for 239Pu and 240Pu (239,240Pu) measured in the six sediment samples were then used to calculate the apparent Pu half-lives for the sediment samples. Using the Pu risk assessment model, apparent half-lives in the range of 7-20 years, were estimated for the different types of Baltic sediment. It was noted that mapping of the distribution of different sediment types in combination with measured apparent half-lives in the respective sediment type would serve as a useful tool in risk assessments of other substances with a pulse-input scenario. (Korn-PTT)
W91-12464

GROUNDWATER QUALITY MODEL WITH APPLICATIONS TO VARIOUS AQUIFERS.
Ain Shams Univ., Cairo (Egypt). Dept. of Irrigation and Hydrology.
M. Soliman, A. El-Mongy, M. Talaat, A. Hassan, and U. Maniak.
Environmental Geology and Water Sciences EGWSEI, Vol. 17, No. 3, p 201-208, May/June 1991. 11 fig, 5 ref.

Descriptors: *Data interpretation, *Groundwater movement, *Model studies, *Path of pollutants, *Solute transport, *Water quality, Aquifer systems, Boundary conditions, Calibrations, Dispersivity, Finite element method, Nile Delta Aquifer, Plumes.

A finite element model was developed in order to solve for both regional groundwater flow and conservative solute transport in a porous medium. The model was applied to two field problems. The first application of the model involved the simulation of an injected contaminant plume for a 55-sq-km groundwater basin in the Ruehen region of Germany. The model area was discretized into 1450 elements and 780 nodes. The model was also used to simulate the problem of salt water intrusion in a 4750-sq-km portion of the eastern Nile Delta aquifer in Egypt. The model was applied to this portion of the delta using a network of 543 elements and 310 nodes. For both application sites, the model proved to be reliable in simulating both groundwater flow and solute transport problems. The successful application of the model to field problems shows that the model parameters are

strongly dependent on the network's geometry, the boundary conditions, and the reliability of field data. It is also concluded that the model dispersivity is many hundred times the theoretical and laboratory values. Concerning the calibrated model parameters, it is recommended that they be regarded as apparent values and that they be independently checked using more reliable data. (Korn-PTT)
W91-12465

EFFECT OF COAL MINE WATERS OF VARIABLE PH ON SPRINGWATER QUALITY: A CASE STUDY.
Institute of Karst Geology, Guilin (China).
Z. Liu, D. Yuan, and Z. Shen.
Environmental Geology and Water Sciences EGWSEI, Vol. 17, No. 3, p 219-225, May/June 1991. 7 fig, 8 tab, 7 ref.

Descriptors: *Acid mine drainage, *Coal mining effects, *Hydrogen ion concentration, *Spring water, *Water pollution sources, *Water quality, Acidic water, Alkaline water, Calcite, Case studies, Correlation analysis, Dissolution, Experimental data, Geochemistry, Neutralization, Oxidation, Pyrite, Weathering.

Disruption of coal strata during mining accelerates pyrite oxidation by exposing greater surface areas of the reactive mineral to weathering. Acidic water in a coal mine in the Niangziguan spring watershed is related to this process and is characterized by low pH (min. 2.52) and high sulfate (max. 4100 mg/l), iron (max. 257 mg/l), and hardness (max. 2274.45 mg/l). However, it is possible that the acidic coal mine water is subsequently neutralized because of the dissolution of calcite present in the coal strata. The hydrochemical characteristics of the alkaline coal mine water produced are high pH (max. 8.18), sulfate (max. 542 mg/l), and hardness (max. 1183.56 mg/l) and lower iron (min. 0.12 mg/l). Experiments were conducted to further understand the mechanism of the formation of both acidic and alkaline waters in the spring watershed coal mines by modeling natural conditions with simplification. The results of the experiments have shown that they are basically successful. The high sulfate (max. 223.82 mg/l) and hardness (max. 435.53 mg/l) of the Niangziguan springs are related to the influence of the neutralized acid coal mine water as demonstrated by analysis of water temperature, total dissolved solid, Q-mode cluster analysis, and sulfur isotopes. The influence of the neutralized acid coal mine water on the pH and iron in the springs is not obvious because of the neutralization effect of calcite in the aquifer, the buffer effect of groundwater, and the precipitation of iron. (Author's abstract)
W91-12466

FLOW IN RIVER CHANNELS: NEW INSIGHTS INTO HYDRAULIC RETENTION.
Freshwater Biological Association, Ambleside (England). Windermere Lab.
For primary bibliographic entry see Field 2E.
W91-12471

STUDIES ON THE ECOLOGY OF AQUATIC BACTERIA OF THE LOWER NIGER DELTA: POPULATIONS OF VIABLE CELLS AND PHYSIOLOGICAL GROUPS.
Port Harcourt Univ. (Nigeria). Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W91-12473

SOURCES AND TRANSPORT OF HYDROCARBONS IN THE RHONE DELTA SEDIMENTS (NORTHWESTERN MEDITERRANEAN).
Paris-6 Univ. (France). Lab. de Physique et Chimie Marines.
I. Bouloubassi, and A. Saliot.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 339, No. 10, p 765-771, April 1991. 6 fig, 35 ref. European Communities 4th R and D Programme Contract EV 4V-0111-F.

Descriptors: *Hydrocarbons, *Marine sediments, *Mediterranean Sea, *Path of pollutants, *Rhone River, *Water pollution sources, Aromatic compounds, Continental shelf, Deltas, France, Seasonal variation.

The Rhone is the major river entering the Mediterranean Sea. It receives both biogenic and anthropogenic inputs from its highly industrialized drainage basin. To assess sources and transport processes for hydrocarbons in the Rhone delta, superficial sediments were collected near the river mouth and at the limit of the continental shelf in February 1985 and September 1986. After spiking with perdeuterated standards and isolation of lipids, a normal-phase high-performance liquid chromatography step permitted the separation of hydrocarbons into non-aromatic hydrocarbons (NAH) and polycyclic aromatic hydrocarbons (PAH), and the fractionation of the latter into subgroups as a function of the number of aromatic cycles. Analysis of fractions and quantitation of individual compounds were performed by gas chromatography (GC) and GC/mass spectrometry. Hydrocarbon concentrations varied 21.2 to 166.7 microgram/g for the NAH, and from 1070 to 6363 nanogram/g for the PAH. Relevant seasonal variations were observed that reflected quantitative and qualitative fluctuations of inputs. Petrogenic, pyrolytic, and natural imprints, as well as their respective contributions, were evidenced by distribution patterns, values of ratios of characteristic compounds, and occurrence of specific components. Pyrolytic inputs were considerably higher in winter, reflecting intense inputs from combustion processes and runoff. In contrast, fossil as well as natural inputs were significantly higher in summer. (Author's abstract)
W91-12478

FORMATION OF TOLUENE BY MICROORGANISMS FROM ANOXIC FRESHWATER SEDIMENTS.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Oekophysiologie.
F. Juttner.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 339, No. 10, p 785-787, April 1991. 2 fig, 3 tab, 12 ref.

Descriptors: *Anoxic conditions, *Aquatic bacteria, *Biotransformation, *Lake sediments, *Path of pollutants, *Toluene, *Water pollution sources, Germany, Lake Edebergsee, Metabolism, Phenylalanine.

Studies in Lake Schleinsee (Germany) had suggested an internal source of toluene. In artificial anoxic lakewater that had been inoculate with anoxic lake sediment (from Lake Edebergsee, Holstein, North Germany), toluene was liberated by microorganisms and accumulated in the water. Phenylalanine, phenyllactate, and phenylpyruvate were effective precursors. Media supplemented with phenylacetate developed toluene in a shorter period of time than the other three compounds. 2-Phenylethanol, phenylacetaldehyde, and phenylacetic acid ethyl ester only weakly supported the formation of toluene. The effectiveness of benzyaldehyde was very low, and cinnamate did not support the formation of toluene at all. The transformation of phenylalanine to toluene was complete, resulting in the formation of stoichiometric amounts. Labelling experiments with deuterated phenylalanine showed no loss of label in the toluene molecule and no dilution by unlabeled toluene. The experiments support the view that phenylalanine that has been liberated from proteinaceous matter by hydrolysis is degraded in anoxic hypolimnia of lakes and anoxic sediments or rivers only to the stage of toluene. The reaction is responsible for accumulation of toluene in these environments. (Author's abstract)
W91-12479

EFFECT OF SALINITY ON PETROLEUM BIODEGRADATION.
Faculte des Sciences et Techniques, Centre de Spectroscopie Moleculaire (URA 1409 CNRS), Av, Escadrille Normandie Niemen, F-13397, Marseille Cedex 13, France.
G. Mille, M. Almallah, M. Bianchi, F. van Wambeke, and J. C. Bertrand.
Fresenius Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 339, No. 10, p 788-791, April 1991. 5 fig 2 tab, 8 ref.

Descriptors: *Aquatic bacteria, *Biodegradation, *Fate of pollutants, *Oil pollution, *Path of pollutants, *Salinity, Aromatic compounds, Crude oil, Metabolism, Natural purification.

Although the effects of temperature on the biodegradation of oil have been studied extensively, little work has been done on the role of salinity in petroleum degradation. The biodegradation of Ashtart crude oil by a mixed bacterial community (EH1) isolated from a marine sediment was investigated in varying concentration of sodium chloride (0 to 2 mole/L). Gas chromatography, UV fluorescence, and Fourier transform infrared spectroscopy (FTIR) were used to study the evolution of each fraction of the crude oil. Each fraction of Ashtart crude oil was biodegraded after a 30-day incubation period for a NaCl concentration equivalent to the one of seawater (0.4 mole/L). Saturates were more readily degraded than aromatics. The amount of oil degraded increased initially with increasing salt concentrations to a maximum level of 0.4 mole/L NaCl. Thereafter the amount oil degraded decreased with increasing salt concentration. The polar fraction increased for the 0.4 to 1.4 mole/L NaCl concentration range. Asphaltenes were degraded only slightly (10%) for a NaCl concentration equivalent to that of seawater (0.4 mole/L). NaCl concentrations seemed to affect the relative biodegradation of pristane and phytane. (Author's abstract)
W91-12480

SPATIAL AND TEMPORAL VARIABILITIES OF HYPOXIA IN THE RAPPAHANNOCK RIVER, VIRGINIA.
Virginia Inst. of Marine Science, Gloucester Point.
A. Y. Kuo, K. Park, and M. Z. Mousutafa.
Estuaries ESTUDO, Vol. 14, No. 2, p 113-121, June 1991. 10 fig, 1 tab, 16 ref.

Descriptors: *Dissolved oxygen, *Rappahannock River, *Spatial variation, *Temporal variation, *Water pollution effects, *Water pollution sources, Benthos, Cycling nutrients, Estuaries, Lagrangian model, Mixing, Model studies, Oxygenation, Streamflow.

Hypoxia/anoxia in bottom waters of the Rappahannock River, a tributary estuary of Chesapeake Bay, was observed to persist throughout the summer in the deep basin near the river mouth; periodic reoxygenation of bottom water occurred on the shallower sill at the river mouth. The reoxygenation events were closely related to spring tide mixing. The dissolved oxygen (DO) in surface waters was always near or at the saturation level, while that of bottom waters exhibited a characteristic spatial pattern. The bottom DO decreased upriver from river mouth, reaching a minimum upriver of the deepest point of the river and increasing as the water became shallower further upriver. A model was formulated to describe the longitudinal distribution of DO in bottom waters. The model is based on a Lagrangian concept--following a water parcel as it travels upriver along the estuarine bottom. The model successfully describes the characteristic distribution of DO and also explains the shifting of the minimum DO location in response to spring-neap cycling. A diagnostic study with the model provided insight into relationships between the bottom DO and the competing factors that contribute to the DO budget of bottom waters. The study reveals that both oxygen demand, either benthic or water column demand, and vertical mixing have a pronounced effect on the severity of hypoxia in bottom waters of an estuary. However, it is the vertical mixing which controls the longitudinal location of the minimum DO. The strength of gravitational circulation is also shown to affect the occurrence of hypoxia. An estuary with stronger circulation tends to have less change for hypoxia to occur. The initial DO deficit of bottom water entering an estuary has a strong effect on DO concentration near the river mouth, but its effect diminishes in the upriver direction. (Author's abstract)

W91-12495

EFFECTS OF SEA SALTS ON THE FORMS OF NITROGEN RELEASED FROM ESTUARINE AND FRESHWATER SEDIMENTS: DOES ION PAIRING AFFECT AMMONIUM FLUX.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2L.
W91-12499

EFFECT OF SALINITY ON AMMONIUM SORPTION IN AQUATIC SEDIMENTS: IMPLICATIONS FOR BENTHIC NUTRIENT RECYCLING.
Academy of Natural Sciences of Philadelphia, PA. Div. of Environmental Research.
For primary bibliographic entry see Field 2L.
W91-12500

RECENT STUDIES OF FLOW AND TRANSPORT IN THE VADOSE ZONE.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 2G.
W91-12508

CONTAMINANT MIGRATION IN IMPERFECTLY KNOWN HETEROGENEOUS GROUNDWATER SYSTEMS.
Waterloo Centre for Groundwater Research (Ontario).
E. A. Sudicky, and P. S. Huyakorn.
Reviews of Geophysics RVGPB4, Vol. Supp, p 240-253, 1991. 161 ref. Natural Sciences and Engineering Research Council of Canada Grant U0508.

Descriptors: *Geohydrology, *Groundwater movement, *Groundwater pollution, *Heterogeneity, *Literature review, *Model studies, *Path of pollutants, *Stochastic hydrology, Field tests.

Recent studies dealing with methodologies for describing contaminant migration in complex groundwater flow systems are summarized in this literature review article. Emphasis is placed on the role played by heterogeneity in the flow and transport properties of geologic media because it is one of the largest sources of uncertainty for making reliable predictions of contaminant plume evolution and remediation. Advancements made in stochastic subsurface transport theories are highlighted along with a complementary discussion of findings based on recent detailed field experiments and progress in numerical modeling techniques. (Author's abstract)
W91-12509

HIERARCHICAL APPROACHES TO TRANSPORT IN HETEROGENEOUS POROUS MEDIA.
Nevada Univ., Reno. Desert Research Inst.
S. W. Wheatcraft, and J. H. Cushman.
Reviews of Geophysics RVGPB4, Vol. Supp, p 265-269, 1991. 2 fig, 1 tab, 49 ref.

Descriptors: *Geohydrology, *Groundwater movement, *Model studies, *Path of pollutants, *Porous media, *Solute transport, Aquifers, Classification, Heterogeneity, Literature review, Soil water.

Most attempts to quantify heterogeneity have been based on the belief that a separation of scale exists between a highly heterogeneous 'small' scale and a 'large' scale which is homogeneous relative to the former. The major distinction between these two scales is that small scale variability is often irrelevant for the prediction of events on the large scale. While it is apparent that cases exist where there is a distinct dichotomy of scales, the more general (and frequent) case will be that heterogeneity exists at all scales. Hierarchical approaches to transport in porous media recognize the natural variability of geologic materials that serve as soils and aquifers. Recently, researchers have begun developing new theories and models of transport and transformation in heterogeneous porous media, based on conceptual models of the hierarchical spatial variability of geologic materials. (Author's abstract)
W91-12511

LEAD AND MOLYBDENUM IN REED AND CATTAIL--OPEN VERSUS CLOSED TYPE OF METAL CYCLING.
Polish Academy of Sciences, Mikolajki. Hydrobiological Research Station.
I. Kufel.
Aquatic Botany AQBODS, Vol. 40, No. 3, p 275-288, June 1991. 10 fig, 5 tab, 26 ref.

Descriptors: *Bioaccumulation, *Cattails, *Lead, *Limnology, *Molybdenum, *Path of pollutants, *Reeds, *Wetlands, Aquatic plants, Heavy metals, Leaching, Macrophytes, Metals, Precipitation, Seasonal variation.

Uptake, leaching from living tissues, and the content in dry standing litter and in decaying plant material of lead and molybdenum were measured in two aquatic macrophytes: common reed and narrow-leaved cattail. The uptake of metals was not related to their supply in littoral sediments. The budget of the metals showed that, in spite of some interspecific differences, lead flowed passively through both plant species. Monthly rain precipitation removed 22% of the maximum amount of lead accumulated in cattail shoots. Substantial amounts of lead remained in dry standing litter of the two plant species for the next season. Conversely, molybdenum taken up in spring was retained in the shoots. Leaching of molybdenum from living tissues was negligible and dry standing litter of reed and cattail was devoid of this metal. Thus, the possible translocation of molybdenum from the shoots to underground organs in autumn is suggested. (Author's abstract)
W91-12517

SUBLETHAL EFFECTS AND BIOACCUMULATION OF CADMIUM, CHROMIUM, COPPER AND ZINC IN THE MARINE AMPHIPOD ALLORCHESTES COMPRESSA.
Australian Nuclear Science and Technology Organisation, Sutherland.
For primary bibliographic entry see Field 5C.
W91-12518

UPTAKE OF CADMIUM IN TROPICAL MARINE LAMELLIBRANCHES, AND EFFECTS ON PHYSIOLOGICAL BEHAVIOUR.
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
B. Patel, and K. Anthony.
Marine Biology MBIOAJ, Vol. 108, No. 3, p 457-470, April 1991. 7 fig, 15 tab, 71 ref.

Descriptors: *Animal physiology, *Bioaccumulation, *Cadmium, *Clams, *Marine life, *Mussels, *Path of pollutants, *Water pollution effects, Biochemistry, Biological studies, Copper, Heavy metals, Intertidal areas, Lethal limit, Tissue analysis, Zinc.

The effect of Cd introduced as inorganic salts, or organic chelates, on the physiological behavior of tropical lamellibranches--arcid blood clams, venerid clams and mytilid mussels collected from various intertidal areas in southern India from 1986 to 1989--was evaluated. Inorganic salts of Cd are reported to completely ionize upon introduction to full-strength sea water and form predominantly (97%) chloride complexes. Some inorganic Cd salts, therefore, would hardly affect physiological parameters. However, bioaccumulation of Cd was greatest upon exposure to Cd introduced as sulfate, followed by iodide, acetate, chloride, nitrate and carbonate; 96-hr LC50s also varied, but in a different order, being highest for chloride (3.5 microgm/mL), followed by nitrate, acetate, iodide and sulfate (1.8 microgm/mL). Furthermore, Cd levels increased linearly with time of exposure and levels in medium, and were species-specific, being highest in the arcid clams, followed by the venerid clams and mytilid mussels. The presence of other metals such as Zn reduced bioaccumulation of Cd significantly, but the reverse was not true. Upon exposure to Cd in the presence of Cu, on the other hand, accumulation of both metals was reduced by 15-20%. In the presence of organic chelators--EDTA, NTA and reduced glutathione (GSH)--Cd accumulation was significantly inhibited, by 1/2 to 1/3. Humic acid, on the other hand, had no effect. Cd levels in soft tissues were inversely related to ambient salinity in the range of 12-32 parts per thousand (ppt). However, both Zn and Cu significantly inhibited Cd accumulation irrespective of salinity. Cd increased the rate of filtration in Anadara granosa over the first 24 h by 28%, but on prolonged exposure (96 hr) that rate decreased significantly, by 50%. Zn alone and in the presence of Cd, on the contrary, initially reduced filtration activity, which subsequently increased to control levels upon continued exposure. Cu alone and in combination with Cd and Zn also significantly inhibited filtration relative to controls. This combination also progressively reduced respiratory activity with time, the maximum decrease being 80% after 96 hr of exposure. (Author's abstract)
W91-12521

CERIODAPHNIA BIOASSAYS OF CUYAHOGA RIVER SEDIMENTS, UPSTREAM AND DOWNSTREAM OF THE AKRON WATER POLLUTION CONTROL STATION.
Akron Univ., OH. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-12522

INFLUENCE OF PAPER MILL EFFLUENT IRRIGATION ON SOIL ENZYME ACTIVITIES.
Tamil Nadu Agricultural Univ., Coimbatore (India). Dept. of Agricultural Microbiology.
For primary bibliographic entry see Field 5E.
W91-12523

SHORT-TERM ACCUMULATION OF CADMIUM BY EMBRYOS, LARVAE, AND ADULTS OF AN HAWAIIAN BIVALVE, ISOGNOMON CALIFORNICUM.
Duke Univ., Beaufort, NC. Marine Lab.
A. H. Ringwood.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 149, No. 1, p 55-56, July 1, 1991. 3 fig, 2 tab, 42 ref.

Descriptors: *Bioaccumulation, *Bivalves, *Cadmium, *Path of pollutants, Animal metabolism, Embryos, Growth stages, Heavy metals, Larvae, Metabolism.

The short-term accumulation of cadmium by embryos, veligers, pediveligers and adults of an Hawaiian bivalve, Isognomon californicum, was evaluated over a 24-hr period. With embryos, there was an 8-hr lag period, which coincided with the time of hatching, before accumulation was observed. With veligers and pediveligers, accumulation began at the time of exposure. Embryos had the highest cadmium accumulation rates. Larval rates were significantly greater than adult rates, but were not believed to be explained by differences in age-specific metabolic rates. Older larvae, pediveligers, had slightly greater accumulation rates than veligers, suggesting that surface area may play an important role in determining short-term accumulation rates. Differences in stage-specific accumulation rates suggest that there may be important differences in metal metabolism during development that are essential to developmental processes. (Author's abstract)
W91-12530

ROLE OF INTERTIDAL MUDBANKS IN THE DIAGENESIS AND EXPORT OF DISSOLVED AND PARTICULATE MATERIALS FROM THE FLY DELTA, PAPUA NEW GUINEA.
Australian Inst. of Marine Sciences, Townsville.
For primary bibliographic entry see Field 2L.
W91-12531

REMOVAL OF PHOSPHORUS AND NITROGEN BY RUNOFF AND SURFACE DRAINAGE: INVESTIGATION OF THEIR CONTRIBUTION TO THE EUTROPHICATION

PHENOMENON(ASPORTAZIONE DI FOSFORO E AZOTO CON LE ACQUE DI DEFLUSSO E DI DRENAGGIO SUPERFICIALI: INDAGINE SUL LORO CONTRIBUTO AL FENOMENO DELL'EUTROFIZZAZIONE).
Naples Univ. (Italy). Ist. di Chimica Agraria.
G. Basile, B. Marano, and G. Cioffi.
Agrochimica AGRCAX, Vol. 34, No. 5/6, p 393-404, December 1990. 3 fig, 6 tab, 10 ref. English summary.

Descriptors: *Agricultural runoff, *Drainage, *Nitrogen, *Nonpoint pollution sources, *Phosphorus, *Water pollution sources, Agricultural chemicals, Agriculture, Fertilizers, Nutrients.

The processes regulating nutrient availability in water environments are briefly examined. The amounts of nitrogen and phosphorus removed from agricultural soils have been checked in water drainage ditches. The water volumes and concentrations of phosphorus and nitrogen removed from the soil have been estimated by means of water balance. Release coefficients were 16.31% for nitrogen (15.82 kg/ha) and 3.47% (0.99 kg/ha) for phosphorus. These values correspond to 4.53 N mg/L and 0.28 P mg/L, which are both very far from the upper limits of pollution risks. Calculations indicate a pronounced difference in nutrient removal between agricultural and urbanized areas. It has been determined that fertilizers are not a significant source of phosphorus enrichment of surface draining waters. (Author's abstract)
W91-12535

CHEMICAL COMPOSITION OF PRECIPITATION COLLECTED ON A WEATHERSHIP ON THE NORTH ATLANTIC.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Air Research.
For primary bibliographic entry see Field 2K.
W91-12540

SEASONAL VARIATIONS IN THE CONCENTRATION OF BE-10, CL(-), NO3(-), SO4(2-), H2O2, PB-210, H-3, MINERAL DUST, AND DELTA O-18 IN GREENLAND SNOW.
Bern Univ. (Switzerland). Physikalisches Inst.
For primary bibliographic entry see Field 5A.
W91-12541

ESTIMATING CLOUD WATER DEPOSITION TO SUBALPINE SPRUCE-FIR FORESTS: I. MODIFICATIONS TO AN EXISTING MODEL.
Tennessee Valley Authority, Muscle Shoals, AL.
For primary bibliographic entry see Field 2B.
W91-12543

SEASONAL FLUCTUATIONS OF ORGANOCHLORINE RESIDUES IN THE PORTUGUESE OYSTER, CRASSOSTREA ANGULATA, FROM THE SADO ESTUARY.
Instituto Nacional de Investigacao das Pescas, Lisbon (Portugal).
O. Castro, A. M. Ferreira, and C. Vale.
Boletim Instituto Nacional de Investigacao das Pescas, Vol. 15, p 23-29, 1990. 5 fig, 18 ref.

Descriptors: *Agricultural chemicals, *Bioaccumulation, *Chlorinated hydrocarbon insecticides, *Fate of pollutants, *Oysters, *Path of pollutants, *Pesticide residues, *Pesticides, *Seasonal variation, Aroclors, DDT, Estuaries, Lipids, Pollutant identification, Polychlorinated biphenyls, Portugal, Reproduction, Sado Estuary.

Polychlorinated biphenyls (PCB) and total DDT residues were measured in soft tissue of Crassostrea angulata from the Sado estuary, Portugal. From October 1985 to January 1987, nine surveys were carried out in the upper Sado estuary and oysters were collected periodically at four stations. The oysters were measured, weighed, dissected and soft tissue composite samples of 25 individuals of similar size were prepared in the laboratory. Seasonal profile concentrations (dry weight) showed a sharp increase in early spring, followed by a decrease to a minimum in early summer. Values of PCB, expressed as Aroclor 1260, ranged from 64 to 745 ng/g and total DDT from 3 to 135 ng/g. Good correlations with lipid content were obtained suggesting that organochlorine seasonal profiles are mostly governed by changes in lipids. Organochlorine concentrations in the entire organism, on a lipid weight basis, were not constant over the year. This may indicate that organochlorines are differently sequestered by different lipids which may change over the reproductive cycle. In addition, organochlorine concentrations in marine organisms may be modified by changes in the organochlorines in the ambient water or in ingested food. Thus, lipid chemistry and environmental changes may both be responsible for this seasonal variation. Total DDT levels seem to be size independent, while PCB size variation is greatly influenced by lipid seasonal content variation. (Agostine-PTT)
W91-12545

REGIONAL WATER FLOW AND PESTICIDE LEACHING USING SIMULATIONS WITH SPATIALLY DISTRIBUTED DATA.
Cornell Univ., Ithaca, NY. Dept. of Soil, Crop and Atmospheric Sciences.
M. C. Petach, R. J. Wagenet, and S. D. DeGloria.
Geoderma GEDMAB, Vol. 48, No. 3/4, p 245-269, May 1991. 6 fig, 8 tab, 33 ref.

Descriptors: *Agricultural chemicals, *Flow discharge, *Leaching, *Model studies, *Nonpoint pollution sources, *Path of pollutants, *Pesticides, *Regional analysis, *Spatial distribution, *Water pollution sources, Annual precipitation, Climatic data, Geographical information systems, Hydraulic properties, Mathematical studies, Simulation analysis, Soil physical properties, Soil types, Solute transport, Time series analysis.

Simulation modeling of water and chemical movement and techniques of Geographical Information Systems (GIS) were used to integrate, condense and summarize the large-scale (order of kilometers) behavior of spatially variable soils to provide management guidance on issues related to pesticide movement in soil. A one-dimensional, convection-dispersion-based solute transport model was used to simulate the movement of four classes of chemicals through layered soils for a 7 km x 10 km site near Albany, New York. The site was divided into a 163 x 112 grid (0.4 ha per cell), with multiple model executions used as a means of incorporating the influence of spatial variability of soil hydraulic properties into the study. Pedotransfer functions based on regression equations were used to relate soil physical properties to the mean and variance of hydraulic properties within each cell. Each model execution used hydraulic properties selected from frequency distributions derived from these parameters. Land use, soil, and slope maps were overlain with a GIS to stratify the grid cells appropriate for modeling. Time series plots for mean and variance of water flux, solute mass, and solute flux were produced based on 25 1-year simulations for each hydraulic group, using local climatic data. Two climatic conditions were analyzed, a very 'wet' year (90th percentile of the population of total annual precipitation) and a mean precipitation year. The calculated solute fluxes are discussed in terms of the implications for pesticide management and estimating potential leaching hazards at the study site. It is not appropriate to predict accurately a mean flux for an entire region. An alternate approach such as mapping the spatial behavior of the flux and its uncertainty should be considered when making policy decisions on pesticide leaching. (Author's abstract)
W91-12547

GROWTH OF PERENNIALS AND LEACHING OF HEAVY METALS IN MEDIA AMENDED WITH A MUNICIPAL LEAF, SEWAGE SLUDGE AND STREET SAND COMPOST.
Connecticut Agricultural Experiment Station, New Haven.
G. J. Bugbee, C. R. Frink, and D. Migneault.
Journal of Environmental Horticulture JEHOD5, Vol. 9, No. 1, p 47-50, March 1991. 1 fig, 4 tab, 18 ref.

Descriptors: *Compost, *Heavy metals, *Leaching, *Leaves, *Plant growth, *Sludge utilization, *Soil amendments, Fertilizers, Hydrogen ion concentration, Loam, Peat soils, Sandy soils, Topsoil.

Municipal leaves, sewage sludge, and street sand were composted by a modified Beltsville aerated pile technique. Rooted cuttings of asters and Sedums were grown for 4 months in 2 L (2 qt) containers filled with media containing 0, 10, 30, 60, 80 and 100% (by volume) compost. The medium with 0% compost contained loamy sand topsoil, peat, sand and Styrofoam pellets (1:5:2:2 by vol). The pH of all media was between 6.0 and 7.0. Half the containers in each treatment received liquid fertilization in mid-season and half did not. Leachate from the containers was collected at monthly intervals and analyzed for the heavy metals Cd, Cr, Cu, Mn, Ni, Pb and Zn to determine their potential for leaching. Growth of perennials was equal or greater in all media containing compost, compared to the medium containing no compost. Liquid fertilizer further improved growth. Adding compost increased media aeration, available plant nutrients and heavy metals and decreased moisture retention and bulk density. Heavy metal concentrations in leachate were low, probably due to the near neutral media pH, and not likely to pose an environmental risk. (Author's abstract)
W91-12548

SULPHUR INPUTS FROM RAINFALL THROUGHOUT NEW ZEALAND.
Ruakura Agricultural Research Center, Hamilton (New Zealand).
S. F. Ledgard, and M. P. Upsdell.
New Zealand Journal of Agricultural Research NEZFA7, Vol. 34, No. 1, p 105-111, 1991. 3 fig, 2 tab, 19 ref.

Descriptors: *Acid rain, *New Zealand, *Precipitation, *Sulfur, *Water pollution sources, *Wetlands, Coasts, Correlation analysis, Leaching, Mathematical analysis, Model studies, Nutrients, Prediction, Temporal variation, Variability.

Temporal variability in S inputs from rainfall was examined between 1983 and 1989 at four sites within the Waikato and King Country regions of New Zealand. The amount of S deposited in rainfall at the four sites showed little annual variability. In general, the S concentration in rainfall was inversely related to the amount of rainfall. Data from these four sites, and published and unpublished data from 30 other sites throughout New Zealand, were used to evaluate the source of S in rainfall and to determine the main factors influencing the amount of S deposited in rainfall using multiple correlation analysis. Analysis of ratios of S to chloride indicated that sea-salt contributed circa 80% of S in rainfall near the coast and it declined to 10% inland. Of several site parameters examined, the best single predictor of S in rainfall was the distance from the nearest coast. The accuracy of prediction was significantly improved by inclusion of a quadratic function of the annual rainfall. The most accurate model involved separate equations for sites nearest the west or east coasts and utilized distance from the coast and the amount of annual rainfall. Measurements of S in rainfall varied between 0.5 and 15 kg S/ha/yr, being highest near the coast. Thus, in coastal areas, where soils and climate do not generate large leaching losses, inputs of S in rainfall may almost meet the annual S requirements of grazed pasture. (Author's abstract)
W91-12552

CORRELATION OF FLURIDONE AND DYE CONCENTRATIONS IN WATER FOLLOWING CONCURRENT APPLICATION.
Florida Univ., Gainesville. Dept. of Agronomy.
For primary bibliographic entry see Field 5A.
W91-12554

SIMULTANEOUS TRANSPORT OF PARENT AND DAUGHTER COMPOUNDS IN AQUIFERS WITH LINEAR FIRST-ORDER SORPTION KINETICS.
Oregon State Univ., Corvallis. Dept. of Soil Sci-

ence.
F. T. Lindstrom, and L. Boersma.
Journal of Contaminant Hydrology JCOHE6, Vol. 7, No. 4, p 301-335, June 1991. 10 fig, 3 tab, 33 ref, 3 append.

Descriptors: *Adsorption kinetics, *Groundwater chemistry, *Leachates, *Mass balance, *Mathematical models, *Path of pollutants, *Sorption, Adsorption, Advection, Desorption, Dispersion, Simulation analysis.

In soils, daughter compounds may be generated from a parent compound by microbial metabolism, chemical reactions, radioactive decay, or other mechanisms. These daughter compounds are also acted upon by physical, chemical, and biological processes in soil resulting in a system referred to as a cascade or chain of compounds system. Important problems in soil science concern the movement of leachate released by sources containing potentially harmful chemicals. Much attention has been given to this problem by applying the linear equilibrium assumption uniformly to all transport and reacting compounds. Little attention has been given to the simultaneous transport and fate of a parent-daughter chain with a first-order rate assumed for the adsorption-desorption kinetics of each compound and with the soil partitioned into three sorption classes. A general one-dimensional cascade or chain model for the simultaneous transport of parent and daughter compounds in sorbing, homogeneous, water table aquifers is presented. The model is based on an advective-dispersive mass accounting formulation for both compounds and includes: (1) first-order rate of conversion of parent to daughter; (2) first-order rates of loss of either parent or daughter or both due to metabolism, chemical reaction and/or irreversible processes; (3) partitioning of the aquifer material into three sorption classes, namely mildly sorbing, strongly sorbing, and organic matter; (4) linear first-order kinetic rules for adsorption and desorption operating on each of the sorbing soil fractions for each compound; (5) constantly emitting sources of rectangular shape of parent compound; and (6) mass accounting boundary conditions and a tailorable initial distribution on (0, infinity). Mathematical analysis yields a coupled, linear system of equations including two transport and fate equations, initial and boundary data, and six kinetic rules, namely three each for parent and daughter compound. A numerical scheme for solving the system of equations was developed using readily available procedures since analytical solutions could not be found. Solutions for scenarios based on leaking underground sources are presented. (Author's abstract)
W91-12556

LONG-TERM EFFECTS OF SOIL HETEROGENEITY ON CADMIUM BEHAVIOUR IN SOIL.
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Plant Nutrition.
A. E. Boekhold, and S. E. A. T. M. Van der Zee.
Journal of Contaminant Hydrology JCOHE6, Vol. 7, No. 4, p 371-390, June 1991. 5 fig, 5 tab, 38 ref, 1 append.

Descriptors: *Adsorption, *Cadmium, *Heterogeneity, *Model studies, *Path of pollutants, *Soil properties, *Soil-water-plant relationships, Barley, Leaching, Monte Carlo method, Root zone, Sandy soils, Sorption.

A deterministic model for long-term behavior of contaminants in the rootzone is developed that includes sorption, leaching, and plant uptake. The model is applied to cadmium accumulation in a sandy soil and uptake of cadmium by barley. Sensitivity analysis showed that the sensitivity of the leaching rate to changes in soil chemical and soil physical parameters decreases as a function of time, and becomes zero when steady state is reached. In contrast, accumulation of cadmium in soil and the plant uptake rate of barley are increasingly sensitive to soil chemical and soil physical parameters as time proceeds. To analyze cadmium behavior in a field that is heterogeneous with respect to soil physical properties, the interstitial flow velocity was assumed to be a random, lognormally distributed variate. Using Monte Carlo simulation, the average plant uptake rate appeared to be much higher in the stochastic analysis than in the deterministic approach. Steady state is reached after a very long period of time. For a lognormally distributed proton activity, causing heterogeneity with respect to the sorption capacity of the soil, the model predicted similar deviations from the deterministic approach. It is concluded that reference values for groundwater and crop quality are exceeded earlier in a heterogeneous field than in a homogeneous soil profile. Moreover, when average values suggest an acceptable situation, variability of the leaching rate and the plant uptake rate can still cause exceedance of reference values in part of the field. Therefore, it is reasoned that environmental quality standards should take soil heterogeneity into account. (Author's abstract)
W91-12558

INVESTIGATION OF A NEW APPROACH TO PREDICT WATER QUALITY EXTREMES WITH A CASE STUDY OF CHEMICAL DETERMINANDS IN STREAM WATER.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
A. J. Jakeman, P. G. Whitehead, A. Robson, J. A. Taylor, and J. Bai.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 25-33, 1991. 3 fig, 4 tab, 5 ref.

Descriptors: *Acidification, *Estimating, *Model studies, *Statistical models, *Stochastic models, *Water quality, *Water quality trends, Chemical composition, Data interpretation, Model testing, Prediction, Probability distribution, Simulation analysis.

Management of many water quality problems could be significantly improved if the timing and magnitude of environmentally damaging events could be predicted. Mathematical models of complex environmental processes associated with water quality behavior are often only capable of reasonable prediction for long-term trend values (e.g., annual or seasonal averages) of the pollutant species of interest. However, many problems occur on a short time scale so that knowledge of the extremes can be just as important as long term means. A new modeling approach was employed to predict these environmental extremes. The water quality data used in the investigation comprised weekly observations on stream water chemical determinands from the Birkenes catchment in Norway. The approach combines features of process-based or deterministic models and purely stochastic or statistical models. The deterministic model simulates long-term (non-stationary) trend values of environmental variables, while the statistical model provides probability distributions which are superimposed on the trend values to characterize the frequency of shorter term concentrations. The resulting hybrid model is sensitive to climate forcing factors and controllable management variables, but recognizes the inherent uncertainty or randomness of the behavior of water quality indicators. The outcome of the study revealed that accurate results could be achieved even when predicting the maximum of the distribution. However, accuracy will depend on the adequacy of the trend model component and the degree to which the assumption that observations are independent and identically distributed (iid) is satisfied. (See also W91-12568) (Korn-PTT)
W91-12572

OPTIMIZING WATER QUALITY MODELING IN AN UNCERTAIN ENVIRONMENT.
Texas Univ. at Dallas, Richardson. Inst. for Environmental Sciences.
J. J. Warwick.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 41-48, 1991. 5 fig, 1 tab, 6 ref.

Descriptors: *Dissolved oxygen, *Mathematical models, *Model studies, *Optimization, *Water quality, Calibrations, Data interpretation, Statistical analysis, Statistical methods, Uncertainty, Variability.

Optimization of the overall modeling exercise must incorporate consideration of both model aggregation error (level of complexity) and input parameter uncertainty. Focusing on one issue, to the exclusion of all others is generally not an optimal situation. Two distinct stream dissolved oxygen model formulations, each representing a different level of simulation complexity, were compared. A non-parametric statistic, the total likelihood (Ltotal) of successfully verifying a calibrated model, was chosen as the point of comparison. For normal levels of input parameter uncertainty and a minimum required dissolved oxygen accuracy of +/-0.25 mg/L, the simpler single parameter model (Ltotal = 24.3%) had superior performance characteristics compared to the complex dual parameter model (Ltotal = 15.0%). In general, the performance (Ltotal) of the complex model improved more rapidly than the simple model following a reduction of input parameter variability. (See also W91-12568) (Author's abstract)
W91-12574

TETRANS: A USER-FRIENDLY, FUNCTIONAL MODEL OF SOLUTE TRANSPORT.
Agricultural Research Service, Riverside, CA. Salinity Lab.
D. L. Corwin, and B. L. Waggoner.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 57-65, 1991. 2 fig, 12 ref.

Descriptors: *Computer models, *Data processing, *Model studies, *Path of pollutants, *Soil water, *Solute transport, *TETrans Model, *Unsaturated flow, *Vadose zone, Chlorides, Computer programs, Data interpretation, Groundwater pollution, Preferential flow, Trace elements.

A beta-test version of the TETrans (acronym for Trace Element Transport) program has been developed which models the movement of inorganic solutes through the vadose zone under transient-state conditions. TETrans is a complete software package consisting of an interactive tutorial, user's guide, and applications software. Both IBM-compatible and Macintosh versions are available to users. The transport model utilizes a mass-balance approach to determine solute concentration distributions over time and solute-loading to the groundwater. Several modeling options are available for simulating such transport-influencing factors as plant-water uptake, hydraulic bypass, and adsorption. All functions are available from pull-down menus, and simulation results are displayed in text and graphic windows. Test data are shown which include a comparison of simulated and measured results for the movement of chloride through a soil lysimeter column over a 900-day study period. Excellent agreement is found when a single parameter for bypass is used. TETrans is distinguished from other transport models in the straightforward manner in which it handles the exacerbating problem of hydraulic bypass. The bypass parameter, termed the mobility coefficient, is determined from simple chemical analysis of chloride in the soil solution through the soil profile following the application of a plug of chloride in the irrigation water. The mobility coefficient reflects the volume of soil water which is not subject to piston displacement. (See also W91-12568) (Author's abstract)
W91-12576

SYSTEM MODELING APPROACH FOR SOLUTE TRANSPORT THROUGH UPPER SOILS.
Hawaii Univ., Honolulu. Dept. of Civil Engineering.
C. C.K. Liu, J. S. Feng, and W. Chen.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 67-72, 1991. 3 fig, 8 ref. U. S. Geological Survey Grant No. 14-08-0001-G1489.

Descriptors: *Agricultural chemicals, *Model studies, *Path of pollutants, *Soil contamination, *Solute transport, *Systems analysis, Data interpretation, Fenamiphos, Groundwater pollution, Pesticides, Simulation analysis, Sorption.

Solute transport through upper soils has been traditionally simulated by following a physically based modeling approach. An alterative modeling ap-

proach was developed using the system theory approach, whereby the overall behavior of a system is represented by its impulse response function, and the system output can be determined simply by a convolution operation of the input and impulse response function. In the system approach, dynamic relations between the input of the chemical at the soil surface and subsequent downward movement are represented by system response functions that do not require knowledge of the intimate structure of relevant transport mechanisms. System modeling techniques were developed and applied to simulate the transport of the pesticide fenamiphos in Hawaiian soils. A comparison of the calculated concentration distribution with actual field measurements shows that the system model provides a satisfactory transport simulation. Chemical transport in sorptive and aggregated soils is significantly affected by the bypassing mechanism of inactivation and reactivation of chemicals in mobile and immobile soil waters. Effects of these mechanisms were demonstrated using the derived system response functions. Generally, the derived response functions consist of two segments--an abrupt increase followed by a gradual exponential decay. This means that fenamiphos is inactivated quickly in immobile water and by soil sorption, and is then reactivated slowly when cleaner, mobile water arrives. (See also W91-12568) (Korn-PTT)
W91-12577

WATER POLLUTION SIMULATION OVER A RIVER BASIN USING A COMPUTER GRAPHIC MODEL.
Academia Sinica, Beijing (China). Inst. of Systems Science.
S. Chen.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 101-108, 1991. 7 fig, 1 tab, 5 ref.

Descriptors: *Computer models, *Simulation analysis, *Water pollution control, *Water quality, *Water resources management, Case studies, China, Computer programs, Computer-aided design, Data interpretation, Databases, Decision making, Decision support systems, Graphical analysis, Graphical methods, Hun-Tai River Basin, Model studies.

A Computer Graphic Model (CGM) has been developed for the personal computer to simulate river water pollution and planning. With the aid of the common software AutoCAD, a color map of a complex river system was created and a suite of graphic symbol blocks, such as pollution source, water intake, and wastewater treatment plant, was designed to fit the needs of basin pollution management and planning. A person can insert, move/remove or modify these symbol blocks in the CGM of the river basin freely. While a new idea is confirmed, a simulation program POLSIM (written with AutoLisp) can be started which redraws the river with different width and color by the mean flow quantity and water quality. A CGM simulation was successfully used in a case study of the Hun-Tai river basin located in the northeast of China. The complex system looked clearer when shown in a CGM form. In addition, a group of pollution maps derived from the river basin CGM gave an intuitional and a total sense perception of the water quality situation in the complicated river system. The methodology of CGM makes the planning process of basin water pollution control easier, visual and interactive. CGM is a friendly tool to link the decision maker, planner, and system analyst with active graphics. (See also W91-12568) (Korn-PTT)
W91-12580

SEDIMENT TRANSPORT MODEL FOR LAKE KETEL (THE NETHERLANDS): A TOOL FOR WATER MANAGEMENT.
Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
G. Blom, and C. Toet.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 141-148, 1991. 4 fig, 2 tab, 15 ref, 2 append.

Descriptors: *Lake Ketel, *Model studies, *Path of pollutants, *Sediment transport, *Sedimentation, Data interpretation, Heavy metals, Lake sediments, Sediment contamination, Simulation analysis, Suspended solids, The Netherlands, Water quality management.

In Lake Ketel (The Netherlands), the bottom sediment is contaminated with heavy metals and organic micropollutants. Lake Ketel is a shallow lake which remained after the construction of new polders in the Lake IJssel area. To simulate the effect of management options on the transport of polluted bottom sediment, STRESS-2d, a 2-dimensional model for sediment transport, resuspension, and sedimentation in shallow lakes was adapted for Lake Ketel. The results of the investigation revealed that the model provided a reasonable reconstruction of the suspended solids concentrations in Lake Ketel and the total suspended solids transport to Lake IJssel. However, simulation of the effects of management options on the composition of the upper sediment layer and the transport of polluted 'old' sediment to Lake IJssel requires long term simulation runs (a simulation period of several years), which are impossible with complex models like the STRESS-2d model. An extrapolation of simulation results over a relatively short period is necessary, but leaves a significant uncertainty about the effects over a long period. This uncertainty in parameter values proved to be a serious problem in simulation runs over a longer period. Although a significant uncertainty about the effects of the simulated dredging pit on the input to Lake IJssel remains, one thing seems to be certain: it leads to a reduction of only about 10-30%. This management option results in a continuous transport of large amounts of polluted bottom sediment to Lake IJssel, which is an important conclusion for the management authorities. (See also W91-12568) (Korn-PTT)
W91-12585

HYDRODYNAMIC WATER QUALITY SIMULATION--AN APPROXIMATIVE SOLUTION.
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft.
E. Ristenpart, and D. Wittenberg.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 157-163, 1991. 3 fig, 6 ref.

Descriptors: *Combined sewer overflows, *Combined sewers, *Mathematical models, *Model studies, *Simulation analysis, *Urban drainage, *Water quality, Boundary conditions, Calibrations, Data interpretation, Flow characteristics, Hydrodynamics, Mass transport, Nitrogen, Phosphorus, QUAL2ED model, Water pollution.

Impacts from combined sewer systems on receiving waters are heavily polluting small river ecosystems. A simulation model has been developed which can be used to predict the development of water quality after combined sewer overflows (CSOs) and other impacts from the urban drainage system. The QUAL2ED water quality model was modified and applied to a system of small wetland creeks in northern Germany which are mainly loaded by combined sewer overflows and diffuse inflows of nitrogen and phosphorus from agricultural areas. This model works with hydrodynamic flow calculations because it is applied in a system of small wetland creeks with nonstationary flow conditions. Two independent sets of measurement data exist and were used for the calibration and verification of the water quality model. The results of the modeling study revealed that the influence of hydraulic boundary conditions in rivers on the constituent conversion and transport processes were immense In addition, the investigation showed that water quality simulations based on a one-dimensional mass transport equation, were possible for nonstationary flow conditions, and that these models would be very useful in urban drainage planning. (See also W91-12568) (Korn-PTT)
W91-12587

REAL-TIME MATHEMATICAL MODEL FOR THREE-DIMENSIONAL TIDAL FLOW AND WATER QUALITY.
South China Inst. for Environmental Sciences, Guangzhou.
For primary bibliographic entry see Field 2L.
W91-12589

MODELING AND ANIMATION OF WASTEWATER DISPOSAL IN THE OCEAN ENVIRONMENT.
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W91-12590

CORMIX: AN EXPERT SYSTEM FOR MIXING ZONE ANALYSIS.
Cornell Univ., Ithaca, NY. DeFrees Hydraulics Lab.
G. H. Jirka, R. L. Doneker, and T. O. Barnwell.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 267-274, 1991. 2 fig, 2 tab, 12 ref.

Descriptors: *Data processing, *Expert systems, *Model studies, *Path of pollutants, *Wastewater dilution, *Water pollution control, *Water quality, Computer programs, Computers, Data interpretation, Diffusion, Flow characteristics.

United States water quality policy includes the concept of a mixing zone, a limited area where initial dilution of a discharge occurs. Current practice in mixing zone analysis is plagued by a number of problems--mixing zone definitions vary widely; there is a diversity of discharge and site conditions; existing models focus on near-field mixing, while legal definitions extend to greater distances; and there are a large number of permitting applications needing review. The Cornell Mixing Zone Expert System (CORMIX) is a series of software elements for the analysis and design of submerged buoyant or nonbuoyant discharges containing conventional or toxic pollutants into stratified or unstratified waters; emphasis is placed on the geometry and dilution characteristics of the initial mixing zone. Subsystem CORMIX I deals with single port discharges, CORMIX 2 addresses multiport diffusers, and subsystem CORMIX 3 analyzes surface discharges. The software is implemented on microcomputers using the MS-DOS operating system. It contains two key elements--(1) a rigorous flow classification scheme that analyzes the near-field behavior of a discharge and 2), a collection of predictive elements for each discharge scenario. By using a combination of expert system and simulation techniques, CORMIX is able to address both quantitative and qualitative aspects of mixing zone analysis. The coupling of a state-of-the-art hydrodynamic mixing knowledge based with appropriate mixing zone models is a useful approach for complex assessment problems. (See also W91-12568) (Korn-PTT)
W91-12600

INNOVATIVE APPROACH TO DETERMINE RETARDATION FACTORS OF ORGANIC CONTAMINANTS IN GROUNDWATER SYSTEMS.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
J. A. Perlinger, and S. J. Eisenreich.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-195792. Price codes: A13 in paper copy, A02 in microfiche. Final Report, January 1991. 264p, 68 fig, 8 tab, 35 ref, 4 append. (M.S. Thesis by J.A. Perlinger, April 1990.) USGS Contract No. 14-08-0001-G1638.

Descriptors: *Groundwater, *Headspace analysis, *Minerals, *Organic pollutants, *Sorption, Alkylbenzenes, Aluminum oxide, Henrys Law, Mineral sorbents.

To elucidate the mechanism and magnitude of sorption of hydrophobic organic chemicals (HOCs) to mineral surfaces, sorption experiments were conducted using a homologous series of alkylbenzenes (benzene, toluene, ethylbenzene, propylbenzene, butylbenzene) and well-characterized mineral sorbents. A headspace analysis system was constructed, characterized, and the methodology developed for studying sorption to mineral solids. This method determines the activity of the analyte in the headspace in equilibrium with water

(Henry's Law) or with mineral solids. Henry's Law constant for the alkylbenzenes was determined repeatedly as a function of temperature (5 to 30 C) and ionic strength (0.0004 to 0.02 M) at constant pH = 7.0. The method delivered precise measurements of Henry's Law (+ or -2%) and sorption coefficient (+ or -2% to 10%). Sorption isotherms suggest that alkylbenzenes sorbed to the surface enhanced benzene sorption at high surface coverages with little evidence of surface association at low surface coverages. Increasing solids concentration unexpectedly resulted in the decrease of the sorption constant. A general mechanism for the sorption of HOCs to mineral solids is proposed. (USGS)
W91-12626

BACTERIAL TRANSFORMATIONS OF NITRATE AND ALDICARB (TEMIK) IN ANOXIC GROUNDWATERS OF LONG ISLAND.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. P. Schubauer-Berigan, D. G. Capone, J. K. Cochran, J. Kazumi, and N. Epler.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-195826. Price codes: A05 in paper copy, A01 in microfiche. Final Report, October 1990. 78p, 28 fig, 10 tab, 195 ref. USGS Contract No. 14-08-0001-G1282.

Descriptors: *Aldicarb, *Bacteria, *Biodegradation, *Groundwater pollution, *Microbial degradation, *New York, *Nitrates, *Path of pollutants, *Water pollution sources, Aerobic conditions, Anaerobic conditions, Anoxic conditions, Denitrification, Isotopic studies, Long Island, Sediments, Upper Glacial Aquifer.

Studies were performed on the microbial transformation of nitrate and aldicarb and groundwater aging methods in the Upper Glacial aquifer of Long Island, NY. Microbial experiments were performed on sediments cored from 1.5 and 15 m. Study transects were established at two sites, Connetquot State Park and Jamesport. Aging studies were performed on pumped well water. Microbial degradation pathways and degradation rates, were examined under both aerobic and anaerobic conditions. Bacterial numbers and activity (using 14C-glucose and 3H-thymidine) were also quantified. Most if not all of nitrate reduction and aldicarb degradation was biologically mediated. Denitrification rates in aquifer sediments on a per gram basis were low (when compared to many solids and aquatic sediments), but depth integrated rates were as high as rates for sediments from other ecosystems. Aldicarb was also degraded at low rates, but more readily under anaerobic vs. aerobic conditions. Aldicarb degradation rates were highest for areas previously exposed to this contaminant, suggesting adaptation of the bacterial populations to degrade aldicarb. Aging groundwater using radium isotopes, 226Ra and 228 Ra, proved unsuccessful. A method developed using anthropogenic chlorofluoromethanes as chronometers for groundwater flow proved successful as determined by a validated transport model. (USGS)
W91-12629

LABORATORY INVESTIGATION OF RESIDUAL LIQUID ORGANICS FROM SPILLS, LEAKS, AND THE DISPOSAL OF HAZARDOUS WASTES IN GROUNDWATER.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5E.
W91-12630

NATURE AND RATES OF BACTERIAL METABOLISM IN THE AQUIFERS OF SOUTHEASTERN LOUISIANA.
Louisiana State Univ., Baton Rouge. Dept. of Geology and Geophysics.
E. R. Graber, and P. Aharon.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-192344. Price codes: A06 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute, Baton Rouge, Final Report, September 1990. 100p, 25 fig, 1 tab, 45 ref, 2 append. USGS Project No. G1565-02.

Descriptors: *Bacteria, *Bacterial metabolism, *Geohydrology, *Isotopes, *Louisiana, *Path of pollutants, *Sodium-bicarbonate waters, *Water chemistry, Aquifer characteristics, Calcite dissolution, Carbon dioxide production, Groundwater chemistry, Ion exchange, Organic matter, Oxidation, Silicate dissolution, Southern Hills Regional Aquifer System.

High Na-HCO3 water in the stacked sand and clay aquifer system of Southeastern Louisiana was found to be caused by a combination of bacterial oxidation of organic matter, ion exchange, and calcite dissolution. Dissolution of feldspar had little impact on water chemistry. Na and alkalinity are highly correlated as a result of calcite dissolution and subsequent exchange by clays of 2 Na ions for each Ca ion. Na content is a good indicator of the amount of calcite dissolved. The contribution to the carbon budget by bacterially-mediated organic degradation is substantial and coequal to the contribution by calcite dissolution. Microbial activity is dominated by aerobic bacteria, and there is little or no contribution by either sulfate-reducers or methanogens. Bacterial activity is concentrated within the deeper aquifers, and is much less important in the shallow and intermediate sands. The average rate of CO2 production is estimated to be 0.0054 mmol/L/yr while in high CO2 productivity areas, rates are more than ten times greater (0.064 mmol/L/yr) (Aharon-LA State U)
W91-12636

PATHWAYS, MECHANISMS, AND RATES OF SOLUTE TRANSPORT ACROSS THE BASE OF THE FRESH WATER ZONE, SOUTH LOUISIANA.
Louisiana State Univ., Baton Rouge. Dept. of Geology and Geophysics.
J. S. Hanor.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-192393. Price codes: A08 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute, Baton Rouge, Project Completion Report, October 1989. 161p, 60 fig, 5 tab, 81 ref, append. USGS Project No. G1565-04.

Descriptors: *Brines, *Groundwater pollution, *Louisiana, *Path of pollutants, *Saline water, *Saline-freshwater interfaces, *Solute transport, *Transition zone, Lithologic logs, Mixing, Recharge, Regional studies, Salinity, Salt domes, Shallow subsurface studies, Subsurface water, Transition flow, Water supply.

The local occurrence of saline waters at shallow depths in south Louisiana has compromised use of some groundwater supplies. To help develop an understanding of the processes which control the occurrence of saline waters at shallow depths in the region, a one-year investigation was undertaken as the start to a longer-term project to define the nature of the transition zone between fresh and saline waters in a five-parish area south of Baton Rouge. Information on pore water salinity, temperature, and pressure and on sediment lithology was derived from examination of over 100 wire-line spontaneous potential resistivity logs. The configuration of the base of the freshwater zone in southeast Louisiana is influenced both regionally and locally by processes originating at depths as much as 3 km or more in the subsurface. The base of the topographically-driven shallow meteoric groundwater system which is recharged in the vicinity of the Louisiana-Mississippi border north of Baton Rouge shallows dramatically to the south at the northern margin of the south Louisiana salt domes. The local configuration of the base of the regional groundwater system is also influenced by deep-seated phenomena. For example, there is no potable water over the St. Gabriel and Darrow salt domes in Iberville and Ascension parishes south of Baton Rouge. The brackish waters which exist above these domes have not been derived from activities related to oil and gas production but apparently by the natural transport of dissolved salt derived from the two domes, the tops of which are situated at depths of approximately 3.4 and 1.4 km, respectively. Hydraulic processes appear to include the topography-driven flow of meteoric fluids at very shallow depths, density-driven overturn around some salt domes, and pressure-driven flow up faults, at least one of which extends to within 100 m of the surface. There is little evidence for significant vertical compartmentalization of fluids above a depth of approximately 3 km, at least on a regional basis. (Hanor-LA State U)
W91-12641

WATER QUALITY OF LAKES AND STREAMS IN VOYAGEURS NATIONAL PARK, NORTHERN MINNESOTA, 1977-84.
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W91-12654

DETERMINATION OF HYDRAULIC PROPERTIES IN THE VICINITY OF A LANDFILL NEAR ANTIOCH, ILLINOIS, DECEMBER 1987.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-12656

GROUND-WATER CONTAMINATION AND MOVEMENT AT THE DEFENSE GENERAL SUPPLY CENTER, RICHMOND, VIRGINIA.
Geological Survey, Richmond, VA. Water Resources Div.
J. D. Powell, W. G. Wright, D. L. Nelms, and R. L. Ahlin.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4113, 1990. 36p, 24 fig, 3 tab, 9 ref.

Descriptors: *Groundwater pollution, *Organic compounds, *Path of pollutants, *Virginia, *Water pollution sources, Groundwater movement, Plumes, Spills.

Analyses of groundwater from 68 monitoring wells installed downgradient from the eastern boundary of the Defense General Supply Center, Richmond, Virginia indicate that volatile-organic compounds are present in both the upper-unconfined aquifer and the lower-confined aquifer. The principal contaminants in the aquifers are trichloroethene and 1,2-trans-dichloroethene. Chemical analyses and water level data indicate that the unnamed creek flowing along the eastern boundary of the Federal property acts as a hydrologic discharge boundary and prevents eastward movement of contaminated groundwater beyond the creek in the upper aquifer. Analyses of water in lower aquifer wells during 1985-89 indicated that contaminants in the lower aquifer had moved downgradient about 200 ft beyond the boundary of the Federal property. Subsequent analyses during 1989-90 indicate that contaminants have moved as much as 400 ft beyond the boundary of the property in the lower aquifer. The rate of movement of contaminated groundwater in the lower aquifer cannot be determined accurately because of natural degradation processes that deter the downgradient migration of the plume; in addition, precise locations and dates of disposals and spills are not available. Aquifer test data indicate that groundwater flows at about 90 ft/yr in the upper aquifer and at about 200 ft/yr in the lower aquifer. On the basis of the distance the contaminants have moved from their possible sources, contaminant migration is about 20% slower than groundwater flow, indicating that the contaminants are being degraded by natural processes. (USGS)
W91-12658

STEADY-STATE UNSATURATED-ZONE MODEL TO SIMULATE PESTICIDE TRANSPORT.
Geological Survey, Lawrence, KS. Water Resources Div.
A. T. Rutledge, and J. O. Helgesen.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS

Water-Resources Investigations Report 90-4164, 1991. 13p, 5 fig, 3 tab, 15 ref. Project No. KS135.

Descriptors: *Mathematical models, *Model studies, *Path of pollutants, *Pesticides, *Soil water, *Unsaturated flow, Agricultural chemicals, Percolating water, Vadose water, Water pollution.

A simple model of pesticide transport in the unsaturated zone is described; its use in an example problem is demonstrated; and sensitivity to selected variables is presented. The model calculates time of travel and fraction of pesticide remaining in the unsaturated zone as functions of depth. The model is best used for screening purposes, and it is not intended for detailed, site-specific analysis. The model allows for multiple lithologic layers in the unsaturated zone, water content variation with depth, pesticide retardation caused by partitioning, pesticide decay rates that vary between layers, and root uptake of pesticides. The variables to which the model is most sensitive are deep percolation rate, organic carbon content in the lower part of the unsaturated zone, pesticide half-life, and depth to the water table. (USGS)
W91-12662

LIMNOCHEMICAL STUDIES AT SMALL BLACK FOREST LAKES (FRG) WITH SPECIAL EMPHASIS TO ACIDIFICATION.
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. of Zoology.
For primary bibliographic entry see Field 2H.
W91-12682

PARTICIPATION OF BACTERIOPLANKTON IN EPILIMNETIC PHOSPHORUS CYCLES OF LAKE CONSTANCE.
Konstanz Univ. (Germany, F.R.). Inst. fuer Seenforschung und Fischereiwesen.
For primary bibliographic entry see Field 2H.
W91-12684

CONTRIBUTION OF DINITROGEN FIXATION AND DENITRIFICATION TO THE N-BUDGET OF A SHALLOW LAKE.
Humboldt-Univ. zu Berlin (German D.R.). Sektion Biologie.
For primary bibliographic entry see Field 2H.
W91-12698

INFLUENCE OF RESUSPENSION ON SEDIMENT OXYGEN DEMAND (SOD) IN THE LAKES OF DIFFERENT MORPHOLOGY AND TROPHY.
Nicholas Copernicus Univ. of Torun (Poland). Inst. of Biology.
R. Wisniewski.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 898-900, March 1991. 5 fig, 1 tab, 11 ref.

Descriptors: *Cycling nutrients, *Lake Druzno, *Lake Parteczyny, *Lake morphology, *Limnology, *Oxygen demand, *Path of pollutants, *Phosphates, *Phosphorus cycle, *Suspended sediments, Comparison studies, Nutrient concentrations, Water temperature.

The effects of resuspension with respect to sediment oxygen demand (SOD) and phosphate release were investigated in two lakes of different morphology and trophy. Lake Parteczyny is a deep, moderately eutrophic lake, while Lake Druzno is shallow and eutrophic. During in situ measurements in Lake Druzno, PVC tubes inserted into deposits served as incubation vessels. An increase of incubation temperature resulted in both SOD and resuspension SOD (rSOD). Mixing intensity had an influence on the results. After 0.5 hour reaeration rSOD decreased during the next 2 hour resuspension cycle. Resuspension of bottom deposits can intensify the phosphate ion release. Because of the frequent resuspension events in shallow lakes, release of phosphorus to the overlying water can be of great significance to whole lake nutrient metabolism. (Brunone-PTT)
W91-12701

ROLE OF BENTHIC BIOTA IN THE PHOSPHORUS FLUX THROUGH THE SEDIMENT-WATER INTERFACE.
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
For primary bibliographic entry see Field 2H.
W91-12705

RECENT RE-OLIGOTROPHICATION IN MONDSEE (AUSTRIA) AS INDICATED BY SEDIMENT DIATOM AND CHEMICAL STRATIGRAPHY.
Institut fuer Limnologie, Mondsee (Austria).
For primary bibliographic entry see Field 5G.
W91-12716

NUTRIENT CYCLING IN A FRESHWATER REED MARSH.
Vienna Univ. (Austria). Limnologische Lehrkanzel.
A. Gunatilaka.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 980-983, March 1991. 1 fig, 18 ref. AGN/BMWF Grant No. LAD/BC 3b; Fonds zur Forderung der Wissenschaftlichen Forschung No. P6028.

Descriptors: *Aquatic plants, *Cycling nutrients, *Freshwater, *Limnology, *Marshes, *Nutrients, *Path of pollutants, *Wetlands, Decomposition, Groundwater, Nitrogen, Phosphorus, Plant growth, Runoff, Sedimentation.

A nutrient budget was defined for a freshwater marsh fringing a large shallow lake, the Neusiedlersee, in Austria, which has been subjected to strong anthropogenic influences in the last three decades. The main sources of nutrient input into the lake are through permanent and tourist settlements and runoff from agricultural land. The dominant vegetation, Potamogeton australis, which appeared after the last desiccation in 1868 and gradually expanded to form large monospecific stands is an important element of the hydroseral succession of the lake. The lakeward areas of the reed stands in the western part of the lake have very high sediment accretion rates, receiving very fine clay sediments loaded with nutrients. Freshwater tidal habitats show high decomposition rates; frequent flooding may influence decomposition. Nutrient pathways in lake shore marshes are influenced by wet and dry fall, gaseous exchanges, runoff and throughflow, groundwater and export. Of the nitrogen entering the marsh through runoff, only 20% enters the lake, while only a small percentage of phosphorus is retained. Long-term exposure to heavy nutrient loading may significantly reduce wetland ability to retain nutrients. (Brunone-PTT)
W91-12719

PHOTOTROPHIC PROKARYOTES IN A KARSTIC SULPHATE LAKE.
Valencia Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W91-12723

DYNAMICS OF PHOTOTROPHIC BACTERIA IN RELATION TO IRON CYCLE IN A MEROMICTIC BASIN OF LAKE BANYOLES.
Institut d'Ecologia Aquatica, Gerona (Spain).
For primary bibliographic entry see Field 2H.
W91-12726

REGULATORY MECHANISMS AND BEHAVIOUR OF COPPER IN AN INDUSTRIALLY-POLLUTED ACIDIC LAKE IN NORTHERN ITALY.
Istituto di Ricerca sulle Acque, Brugherio (Italy).
M. Camusso, G. Tartari, L. Previtali, and A. Zirino.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1035-1040, March 1991. 4 fig, 4 tab, 15 ref.

Descriptors: *Acid lakes, *Copper, *Industrial wastes, *Italy, *Lake Orta, *Path of pollutants, *Toxicity, *Trace metals, *Wastewater pollution, *Water pollution sources, Dissolved organic carbon, Hydrogen ion concentration, Iron, Lake restoration, Liming, Nitrates, Seasonal variation, Suspended solids, Thermal stratification.

Lake Orta, located in the main Italian subalpine lacustrine area, is an industrially-polluted, acidic waterbody. Lakewaters were sampled monthly at the pelagic station in the north basin over five years, and assayed for total dissolved copper, iron, manganese and hydrochemical parameters (pH, conductivity, dissolved oxygen, ammonium, and nitric nitrogen). In addition to high acidity and high introduced ammonium nitrogen, the lake has low orthophosphate and low dissolved organic carbon, and hence limited algal productivity. Suspended particulate matter is mainly autochthonous with maxima in spring and summer during thermal stratification, since tributary input is relatively low. Copper concentration is low in particulate matter, has a relatively low sedimentation rate of 0.55 tons/year and a mean residence time of 7.8 years. In Lake Orta, the copper distribution is not constant over the year and varies considerably with depth. Interactions between suspended and dissolved phase are important throughout the entire body of Lake Orta, which is different from the other lacustrine environments. Physical, chemical and biological factors, especially pH, suspended particulate matter and iron concentration, are direct regulators of copper behavior throughout the year. Indirectly, algal productivity, in-lake nitrification and resuspension phenomena influence the distribution and removal of copper, whose concentration is still high. Copper is one of the major toxic pollutants of the lake. Liming is expected to change copper regulatory mechanisms, leading to the eventual restoration of the original hydrochemical conditions, and an increase in the number of species of phytoplankton. (Brunone-PTT)
W91-12731

LIMNOLOGY OF LAKE XOLOTLAN, NICARAGUA: AN OVERVIEW.
Centro para le Investigacion en Recursos Acuaticos de Nicaragua, Managua.
For primary bibliographic entry see Field 2H.
W91-12755

MERCURY CONTAMINATION IN LAKE XOLOTLAN (NICARAGUA).
Centro para le Investigacion en Recursos Acuaticos de Nicaragua, Managua.
M. Lacayo, A. Cruz, J. Lacayo, and I. Fomsgaard.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1174-1177, March 1991. 4 fig, 1 tab, 6 ref.

Descriptors: *Lake Managua, *Mercury, *Nicaragua, *Path of pollutants, *Water pollution effects, Bioaccumulation, Correlation analysis, Heavy metals, Population exposure, Toxicity.

The mercury pollution in Nicaragua's Lake Xolotlan (Lake Managua) ecosystem was evaluated in samples of sediment, water, fish tissues, and human hair. Total mercury content was measured spectrophotometrically. Mean concentration of total mercury at the sediment surface was 0.62 +/-0.46 microg/g, a value similar to those measured in industrialized countries. The values progressively diminished farther away from the chlor-alkali plant at Miraflores. Wide fluctuations in concentrations of mercury in the lake water were seen between the point of discharge and the remaining localities, possibly due to a rapid precipitation of mercury and to the great variations in discharged volume. The mean concentration of mercury measured in muscles of the cichlid fishes Cichlasoma managuense and C. citrinellum were 0.63 +/-0.22 microg/g and 0.07 +/-0.14 microg/g, respectively. Ninety percent of the C. managuense and 10.3% of the C. citrinellum exceeded the permissible value (0.4 microg/g) established by the Japanese government after the Minamata Bay mercury-poisoning experience. The mean concentration of mercury measured in the liver of C. managuense

was 0.79 +/-1.29 microg/g and, for C. citrinellum, 0.62 +/-0.44 microg/g. The mean concentration in the hair of 98 fishermen and their families was 5.03 +/-6.2 microg/g and ranged from 0.02 to 38.22 microg/g, but no reliable correlation was obtained between the number of times fish was eaten per week and the mercury accumulation in fishermen and their families. However, hair samples from 32 workers (all male) at the chlor-alkali plant had a mean mercury content of 91.24 +/-156.9 microg/g, and ranged from 0.46 to 724.5 microg/g--concentrations in 28% of the samples were above the limit for mercury illness. (Brunone-PTT)
W91-12760

ABUNDANCE AND ACTIVITY OF BACTERIOPLANKTON IN WARM LAKES.
Instituto de Ciencias del Mar, Barcelona (Spain).
For primary bibliographic entry see Field 2H.
W91-12767

C-14 UPTAKE AND GROWTH RATE OF PHYTOPLANKTON IN CONTINUOUS CULTURES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 7B.
W91-12777

PHOSPHORUS, CHLOROPHYLL AND THE COMPARATIVE LIMNOLOGY OF THREE SUBURBAN LAKES IN NORTHERN VIRGINIA, U.S.A.
North Carolina State Univ., Raleigh. Dept. of Zoology.
G. W. Redfield.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1294-1299, March 1991. 4 fig, 1 tab, 28 ref.

Descriptors: *Chlorophyll, *Eutrophic lakes, *Fate of pollutants, *Limnology, *Phosphorus, *Runoff, *Suburban areas, *Urban runoff, *Virginia, *Water pollution effects, *Water pollution sources, Comparison studies, Epilimnion, Lake Anne, Lake Audubon, Lake Thoreau, Light intensity, Seasonal variation, Storm runoff, Toxicity.

Lakes Anne, Thoreau, and Audobon, in northern Virginia, are eutrophic bodies of water due largely to runoff-borne nutrient loading from their suburban watersheds. Ambient phosphorus in these suburban lakes appears to support chlorophyll a concentrations as in many natural lakes. However, spring overturn total phosphorus levels are not well correlated with summer mean chlorophyll, in contrast to natural lakes. Variability in summer total phosphorus may be driven by runoff events which generally occur every 7 to 10 days during northern Virginia summers. Although external loading from stormwater may increase total phosphorus temporarily, subsequent flocculation and settling are suggested as important mechanisms for summertime losses of total phosphorus from the epilimnia of the lake. Stormwater particulates promote the adsorption of total phosphorus and coflocculation of chlorophyll a. Overall, the resultant settling tends to clear the mixed layer of particulates and reduces the deleterious effects of urban runoff. The phytoplankton cycle may be controlled by flocculation and settling than by washout, light limitation, and toxics. Further research on the nature of urban runoff is needed, particularly regarding processes controlling the settling of organic and inorganic particles in association with stormwater. (Brunone-PTT)
W91-12783

SAPROPHYTIC AND FAECAL COLIFORM BACTERIA IN THE SEDIMENT OF THE IMPOUNDMENT ALTENWORTH.
For primary bibliographic entry see Field 5A.
W91-12789

PERIODIC INTERANNUAL OSCILLATIONS IN BACTERIAL NUMBERS AND ACTIVITY RELATED TO METEOROLOGICAL CYCLES.
Ceskoslovenska Akademie Ved, Ceske Budejovice. Hydrobiologicka Lab.
For primary bibliographic entry see Field 2H.
W91-12791

LIMNOLOGY OF LOWLAND SHALLOW IMPOUNDMENT NEAR WARSAW, POLAND.
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
Z. Kajak.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1344-1348, March 1991. 2 fig, 2 tab, 21 ref.

Descriptors: *Eutrophication, *Fate of pollutants, *Limnology, *Path of pollutants, *Phosphates, *Poland, *Reservoirs, *Trophic level, *Zegrzynski Reservoir, Adsorption, Copepods, Hypertrophic lakes, Iron, Nutrient concentrations, Sediment chemistry, Sedimentation, Shallow water, Water depth, Water temperature, Zooplankton.

The Zegrzynski Reservoir, created in 1963, has practical importance as one of the main sources of water for Warsaw, Poland. The two main inflows have rather similar flow patterns. Samples of water were taken up to ten times per month during the summer in the central part of the reservoir, and two to three times monthly during the rest of the year with a 1 L Patalas sampler. The trophic status in the reservoir is very high. Only iron and seston are sedimenting in the reservoir in high amounts. The total phosphorus concentration is much higher than in other Polish reservoirs and equal to those in very hypertrophic lakes. Zooplankton is relatively dense, with Copepoda dominant with 50% of overall wet weight. The observed phosphate concentrations are being kept down by compensating mechanisms, like sediment adsorption or seston. The shallowness of the reservoir and the high temperatures at the bottom favor biochemical processes resulting in high phosphate concentrations in bottom sediments and their export to overlying waters. (Brunone-PTT)
W91-12794

CHANGES IN THE TROPHIC STATE OF THE SPANISH RESERVOIRS DURING THE LAST SIXTEEN YEARS.
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W91-12800

REDUCTION OF HEAVY METAL CONTENT IN HIROSHIMA BAY OYSTERS (CRASSOSTREA GIGAS) BY PURIFICATION.
Hiroshima Univ. (Japan). School of Medicine.
Y. Hiraoka.
Environmental Pollution ENPOEK, Vol. 70, No. 3, p 209-217, 1991. 4 tab, 15 ref.

Descriptors: *Bioaccumulation, *Food processing, *Heavy metals, *Hiroshima Bay, *Oysters, Arsenic, Cadmium, Chromium, Copper, EDTA, Iron, Lead, Manganese, Nickel, Zinc.

Cultured oysters from Hiroshima Bay were analyzed to determine the content of nine trace elements, cadmium (Cd), lead (Pb), chromium (Cr), arsenic (As), manganese (Mn), nickel (Ni), copper (Cu), zinc (Zn), and iron (Fe) and compared with oysters treated for 48 hr in both artificial sea water and a solution of 0.5% ethylenediaminetetraacetic acid (EDTA) in artificial sea water. It was found that the values of As and Fe in both groups of treated oysters were significantly lower than in the untreated oysters and that the Pb and Mn levels tended to be lower. It was found that oysters treated in 0.5% EDTA solution in artificial sea water had lower levels of Cd and Cu than the oysters treated only in artificial sea water. (Author's abstract)
W91-12809

DISSIPATION OF SOME ORGANOCHLORINE INSECTICIDES IN CROPPED AND UNCROPPED SOIL.
Haryana Agricultural Univ., Hissar (India). Dept. of Chemistry and Biochemistry.
G. Singh, T. S. Kathpal, W. F. Spencer, and J. S. Dhankar.
Environmental Pollution ENPOEK, Vol. 70, No. 3, p 219-239, 1991. 1 fig, 7 tab, 62 ref.

Descriptors: *Chlorinated hydrocarbon pesticides, *Cropping, *Fate of pollutants, *Insecticides, *Path of pollutants, *Pesticides, *Soil contamination, Agricultural practices, Agriculture, Aldrin, Chlordane, Environmental chemistry, HCH, Heptachlor, Loam, Sandy soils.

Dissipation of four organochlorine insecticides, viz. aldrin, HCH, chlordane and heptachlor was studied in a sandy loam with and without crops during a period of 10 cropping seasons. Dissipation of all chemicals followed first-order kinetics with almost similar persistence in cropped and uncropped soils for all the insecticides. The average half-lives for total residues of aldrin, HCH, chlordane, and heptachlor in cropped treatments were 80.77, 58.5, 93.2, and 110 days. Their respective values in fallow plots were 78.4, 83.8, 154, and 116 days. None of the parent compounds or their isomers could be detected below the 20 cm depth at the termination of the experiment. Highest residue concentrations were observed in the surface 10 cm layer in fallow plots, but in the deeper (10-20 cm) layer in cropped plots. Analysis of plants and grains showed significant residues of all the chemicals. Degradation of these compounds in cropped and uncropped plots is discussed with regard to their volatilization, microbial degradation, leaching, and plant uptake. (Author's abstract)
W91-12810

POLYCHLORINATED BIPHENYLS IN OYSTERCATCHERS (HAEMATOPUS OSTRALEGUS) FROM THE OOSTERSCHELDE (DUTCH DELTA AREA) AND THE WESTERN WADDEN SEA, THAT DIED FROM STARVATION DURING SEVERE WINTER WEATHER.
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
R. H. D. Lambeck, J. Nieuwenhuize, and J. M. van Liere.
Environmental Pollution ENPOEK, Vol. 71, No. 1, p 1-16, 1991. 5 fig, 2 tab, 47 ref.

Descriptors: *Oosterschelde, *Oystercatchers, *Path of pollutants, *Polychlorinated biphenyls, *Water pollution effects, Bioaccumulation, Ecological effects, Lethal limit, Seasonal variation, The Netherlands, Tissue analysis, Toxicity, Water birds, Waterfowl.

Wintering oystercatchers, charadriid shorebirds that chiefly feed on intertidal bivalves, suffered mass mortality in The Netherlands during severe frost in 1986 and 1987. Polychlorinated biphenyls (PCBs) were analyzed in liver and (partially) brain lipids of 96 birds to examine the influence of age (three categories), sex and wintering area (the Oosterschelde estuary versus the westernmost Wadden Sea) on levels, and the risk of intoxication due to starvation. Victims had lost nearly 40% of their normal winter weight. PCB-structures. First-winter Wadden birds had lower levels than subadults and adults, but an age-difference was absent in the Oosterschelde birds. Some juvenile outliers possibly originated from polluted breeding areas. Individual variation was considerable in most categories. Relevant ecological factors are discussed. Although a dam has considerably reduced the direct transport of PCBs into the Oosterschelde since 1969, contamination of local birds was hardly lower than in Wadden winters. Influx of riverine PCBs into the Oosterschelde from coastal water may have been underrated. Starvation increased liver concentrations by a factor of 35; factors for the brain were 56 for juveniles and approximately 120 for older birds. Considering published lethal levels for other species, it is doubtful if PCBs contributed to this winter mortality. (Author's abstract)
W91-12811

PLASTIC PELLETS, TAR, AND MEGALITTER ON BEIRUT BEACHES, 1977-1988.
Prestonsburg Community Coll. KY.

J. G. Shiber, and J. M. Barrales-Rienda.
Environmental Pollution ENPOEK, Vol. 71, No. 1, p 17-30, 1991. 2 fig, 3 tab, 32 ref.

Descriptors: *Beach contamination, *Beirut, *Path of pollutants, *Plastics, *Tar, *Water pollution sources, Beaches, Lebanon, Mediterranean Sea, Oil pollution, Urbanization, Waste disposal.

In the spring of 1988, five beaches along the coast of Beirut were surveyed for the presence of plastic pellets, tar, and megalitter--a follow-up to the studies conducted on the coast of Lebanon in 1977 for plastic pellet and tar occurrence, and in 1978 for containers and other megalitter on Beirut beaches. Plastic pellets were more abundant than they were in 1977 on three beaches and less so on two. Tar, however, seemed to occur much more abundantly on all five beaches. Megalitter, chiefly plastic but also paper, metal, and glass, had increased greatly compared with that seen 10 years ago. As in 1977, the unrestricted waste disposal practices of the plastic manufacturers, plus the possible loss of cargo from ships loading and unloading raw materials, are the most likely sources of plastic pellets. The abundance of tar is not surprising, considering that the Mediterranean Sea is tar-polluted and that two oil terminals occur on Lebanon's coast. Further, local gas stations frequently dump oil and grease onto the beaches, and numerous fires have occurred at coastal refineries over the past 10-15 years. All of these factors are likely to contribute to the presence of tar on the beaches. The main source of the vast quantities of megalitter on the beaches is undoubtedly the Lebanese people themselves, due to numerous population shifts and the lack of order and regulatory enforcement as a result of the civil chaos in the country. In addition, the ships docking or waiting for days, and sometimes weeks, to get into the Lebanese ports probably affect the abundance of megalitter (and tar) on the beaches. (Author's abstract)
W91-12812

ELUTION PROFILES OF THREE CHLORINATED HYDROCARBONS LEACHING THROUGH SANDY SOIL.
Illinois Univ. at Chicago Circle. School of Public Health.
B. A. Bates, G. R. Brenniman, R. J. Allen, and R. J. Anderson.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 117, No. 3, p 279-290, May/June 1991. 3 fig, 6 tab, 16 ref.

Descriptors: *Chlorinated hydrocarbons, *Elution, *Groundwater pollution, *Path of pollutants, *Soil contamination, Chemical analysis, Leaching, Organic compounds, Tetrachloroethylene, Trichloroethane, Trichloroethylene, Volatilization.

The elution of trichloroethylene (TCE), tetrachloroethylene (PCE), and 1,1,1-trichloroethane (TCA) from a sandy soil in a soil column system was investigated by applying each chemical to one of three soil columns. A fourth soil column served as a control. Chemicals were applied to the soil in a nonaqueous form to simulate an accidental spill or discharge. The chemicals were then eluted from the soil with water, which was applied intermittently over a 68-day period. The three chemicals investigated achieved a 1% breakthrough in the following order: TCE > TCA > PCE. In terms of overall elution from the soil, the percentage for TCE leached through the soil (20.4%) was greater than the percentage for TCA (10.7%) and PCE (2.3%). The sequence and rate of elution of the three chemicals agrees best with predictions based on the octanol-water distribution coefficient and the Henry's constant of each chemical. Volatilization of the chemicals had a major impact on the overall elution patterns of the chemicals. (Author's abstract)
W91-12817

ROTENONE PERSISTENCE IN FRESHWATER PONDS: EFFECTS OF TEMPERATURE AND SEDIMENT ADSORPTION.
National Fisheries Research Center, La Crosse, WI.
V. K. Dawson, W. H. Gingerich, R. A. Davis, and P. A. Gilderhus.
North American Journal of Fisheries Management NAJMDP, Vol. 11, No. 2, p 226-231, Spring 1991. 1 fig, 5 tab, 15 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Piscicides, *Rotenone, *Sediment contamination, *Water temperature, Fishkill, Seasonal variation.

The persistence of rotenone was compared between a cement-lined pond (0.04 ha) and an earthen-bottom pond (0.02 ha) treated with 5 microL Noxfish/L (250 microgm rotenone/L) during spring, summer, and fall. Water temperatures on the days of treatment in each season were 8, 22, and 15 C, respectively. Both ponds were filled with pond water from a common source 1 week before each of the three treatments. Water samples (filtered and unfiltered) and sediment samples were analyzed by high-performance liquid chromatography to monitor the decrease of rotenone until residues were at or below the detection limit (< 2.0 microgm/L for water and < 25 ng/g for sediments). The loss of rotenone from water generally followed a first-order rate of decay. Rotenone disappeared two to three times faster in the earthen pond than in the concrete pond. The rotenone half-life times in the spring, summer, and fall treatments were 3.7, 1.3, and 5.2 d, respectively, in the concrete pond, and 1.8, 0.7, and 1.8 d in the earthen pond. Rates of decay in both ponds were directly correlated with water temperature. Filtered water samples from both ponds contained less rotenone thana unfiltered water, indicating that some rotenone was bound to suspended material. The highest concentration of rotenone in sediment samples was 102 ng/g; residues decreased to below the detection limit within 14 d in the spring treatment and within 3 d in the summer and fall treatments. (Author's abstract)
W91-12831

PARAMETERS FOR PREDICTING FATE OF ORGANOCHLORINE PESTICIDES IN THE ENVIRONMENT. (II) ADSORPTION CONSTANT TO SOIL.
Yokohama National Univ. (Japan). Dept. of Material Science and Chemical Engineering.
K. Kawamoto, and L. Urano.
Chemosphere CMSHAF, Vol. 19, No. 8/9, p 1223-1231, 1989. 13 fig, 3 tab, 18 ref.

Descriptors: *Adsorption, *Fate of pollutants, *Halogenated pesticides, *Path of pollutants, *Pesticides, *Soil contamination, Chlornitrofen, Freundlich equation, Mathematical studies, Organic carbon, Organic compounds, Quintozene, Soil properties.

Adsorption isotherms of 10 principal organochlorine pesticies on soils were investigated for predicting their fate in the environment. The adsorption isotherms were expressed using Freundlich-type isotherms; the adsorption constants were approximately proportionate to the organic carbon content for the general soil samples. The adsorption constants per gram of organic carbon in soil ranged from 10 to 10,000. the values for chlornitrofen (34,000) and quintozene (20,000) were at the upper end of this range, while the values for dichlorvos (47), DCIP (47), and trichlorfon (79) were at the lower end of this range. The constant values correlated well with the octanol-water partition coefficients for these chemicals. (See also W91-08015) (Lantz-PTT)
W91-12832

DEVELOPMENT OF ONE DIMENSIONAL WATER QUALITY MODEL FOR ORGANIC POLLUTANTS TRANSPORTED TO SEA FROM THE BLACK-STONE RIVER (IN CHINESE).
National Bureau of Oceanography, Xiamen (China). Third Inst. of Oceanography.
Z. Jinshu, J. G. Quinn, C. G. Carey, and J. T. Ellis.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 22, No. 1, p 44-49, January 1991. 2 fig, 5 tab, 5 ref. English summary.

Descriptors: *Blackstone River, *Fate of pollutants, *Model studies, *Narragansett Bay, *Path of pollutants, *Water quality monitoring, Aromatic compounds, Bottom sediments, Polychlorinated biphenyls, Polycyclic aromatic hydrocarbons, Suspended solids, Water pollution sources.

A one dimensional water quality model for the organic pollutants transported to Narragansett Bay from the Blackstone River, Rhode Island was developed. Samples were taken three times at nine stations along the Blackstone River in summer and autumn 1985. A one dimensional water quality model for the sources, transport and fate of organic pollutants was developed from their chemical analyses and statistics. Results showed that suspended particles, PAHs (polyaromatic hydrocarbons), and PCBs (polychlorinated biphenyls) did not sink to the bottom of the river during the transport, but the total hydrocarbons, phthalates and chloprestnol were present on the bottom. Percentage in bottom sediments was 47% for total hydrocarbons, 65% for phthalates and 75% for choprestnol. (Author's abstract)
W91-12837

PHYSICO-CHEMICAL CHARACTERISTICS OF THE WATERS OF THE SANTA LUCIA RIVER BASIN (URUGUAY) (ESTUDIO DE LAS CARACTERISTICAS FISICO-QUIMICAS DEL AQUA DE UNA ZONA DEL RIO SANTA LUCIA (URUGUAY)).
Universidad de la Republica, Montevideo (Uruguay). Facultad de Humanidades y Ciencias.
S. Mendez, W. Pintos, and C. Lucchi.
Revista de la Asociacion de Ciencias Naturales del Litoral RCNLDW, Vol. 19, No. 2, p 123-133, 1988. 8 fig, 23 ref. English summary.

Descriptors: *Physicochemical properties, *Santa Lucia River Basin, *Uruguay, *Water chemistry, *Water pollution sources, *Water quality, Industrial wastes, Municipal wastes, Nutrients, Stream pollution.

A physico-chemical study of the waters of the Santa Lucia River (Uruguay) was performed. The annual variations of different physicochemical parameters at Paso Pache were related to periods of rain and low water. Seston was augmented by the rains due to transport of river-basin material. No clear relation was observed between nutrient quantity and water volume, but there was a significant correlation between the concentrations of nitrate and ammonium ions. In another study, water quality at Paso Pache was compared with four other stations in the basin. This comparative study of five sampling sites clearly shows a difference between Arroyo Mendoza and the other streams. As evidenced by chloride and calcium ions, a conductivity and alkalinity structure is maintained throughout the course of the Santa Lucia river, and this structure differs somewhat from that of its tributaries. The incidence of urban and industrial wastes in the river water was also investigated. Industrial residues are assumed to be responsible for observed variations in water quality; at the city of Santa Lucia, in addition to such effluents, there are other urban anthropogenic contributions. The domestic wastes of the city of San Ramon affect in minor degree the water quality for a small number of inhabitants. (Shidler-PTT)
W91-12840

WATER CIRCULATION OF THE DANUBE DELTA--ECOLOGICAL AND ECONOMIC SIGNIFICANCE (DER WASSERUMLAUF IM DONAUDELTA--OKOLOGISCHE UND WIRTHSCHAFTLICHE BEDEUTUNG).
Institutul de Geografie, Bucharest (Romania).
For primary bibliographic entry see Field 2E.
W91-12844

APPLICATIONS OF THREE COMPLETELY MIXED COMPARTMENT MODELS TO THE LONG-TERM FATE OF DIELDRIN IN A RESERVOIR.
Polytechnic Univ., Brooklyn, NY. Dept. of Civil and Environmental Engineering.
C. Sato, and J. L. Schnoor.
Water Research WATRAG, Vol. 25, No. 6, p 621-

631, June 1991. 14 fig, 1 tab, 28 ref.

Descriptors: *Computer models, *Fate of pollutants, *Model studies, *Path of pollutants, *Reservoirs, Biodegradation, Chemical properties, Comparison studies, EXAMS II model, Hydrologic properties, SLSA model, Sensitivity analysis, TOAC model, Water chemistry.

Three chemical fate models (SLSA, TOXIC and EXAMS II) were applied to a flood control/recreational reservoir in Iowa to assess the long-term fate of a persistent chemical, dieldrin. These models were validated via calibration, verification and sensitivity analysis based on 16 years of field data sets. The three models were calibrated interactively to supplement the shortcomings of an individual model and minimize differences between them. The results indicated that these models can serve as useful tools for assessing the long-term fate of persistent chemicals, as long as the user is fully aware of the model assumptions and limitations. Through SLSA was very easy to use, its use was limited because it does not account for any spatial variability of the environment, such as water characteristics. SLSA could however, be a useful tool for preliminary assessments, and is especially suited for problems that involve a contaminated sediment regime. EXAMS II was also easy to use and it was the most detailed in chemistry of the three models; EXAMS II adopted a significant amount of chemical and environmental data as input. However, EXAMS II tended to give a higher sediment chemical concentration than was actually measured. This problem was corrected by increasing the rate of biodegradation in the sediment bed. It was decided that TOXIC may be best applied to persistent organic problems that involve a time-variable, continuous chemical loading, and an environment with relatively constant flow and suspended solid concentrations. Major drawbacks were that the current version of TOXIC requires a basic FORTRAN programming skill, working knowledge of kinetic processes, and the ability to adjust the model's computer code for full usage of the mode. Worth noting is that all of the models ignored the short-term variability of hydrologic processes. (Mertz-PTT)
W91-12847

EFFECTS AND DEGRADATION OF 4-CHLORO-3-CRESOL IN A SYSTEM OF NATURAL SELF-PURIFICATION.
Landesanstalt fuer Umweltschutz Baden-Wuerttemberg, Karlsruhe (Germany, F.R.).
G. Frietsch.
Water Research WATRAG, Vol. 25, No. 6, p 717-727, June 1991. 20 fig, 3 tab, 8 ref.

Descriptors: *Biodegradation, *Chlorinated hydrocarbons, *Computer models, *Fate of pollutants, *Model studies, *Wastewater treatment, *Water pollution effects, Ammonia, Kinetics, Nitrification, Oxidation.

For many chemical compounds there is much information about their toxicity and biodegradability, but hardly any ecotoxicological investigations take into consideration how xenobiotic substances are integrated into complex biological systems. It is shown that 4-chloro-3-cresol (CMC), a chlorinated phenolic derivative used as a disinfectant and preservative, was completely eliminated within the process of natural self-purification, initiated in a lab-scaled river model. Biodegradation of CMC occurred after the elimination of other organic compounds (synthetic sewage) which were easier to degrade. The nitrification of ammonia only started after CMC had been completely degraded. The kinetics of substrate oxidation (acetate) measured by oxygen consumption (Warburg-method) were inhibited noncompetitively by CMC. The gradual increase of the CMC concentration in the influent of the plant led to an increasing insensitiveness of the bacterial biocoenosis so that the kinetics of substrate oxidation in the presence of CMC resulted in a decrease of the inhibitory effect (increasing inhibition constant). The rate of CMC degradation referring to the biomass concentration increased with increasing CMC concentration in the influent, which indicated a growth of CMC-degrading bacteria within the total population. CMC degradation itself was inhibited at high concentrations. In addition higher CMC concentrations in the influent of the river model led to a change of (1) the bacterial community and (2) the diversity of ciliates populations. In practice the separation of the processes of the elimination of easily biodegradable substances and of the degradation of CMC (for example, activated sludge reactor and trickling filter) should be considered. (Author's abstract)
W91-12857

SIMPLE, DYNAMIC MODEL FOR THE SIMULATION OF THE RELEASE OF PHOSPHORUS FROM SEDIMENTS IN SHALLOW, EUTROPHIC SYSTEMS.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
D. T. Van der Molen.
Water Research WATRAG, Vol. 25, No. 6, p 737-744, June 1991. 5 fig, 2 tab, 19 ref.

Descriptors: *Eutrophic lakes, *Lake sediments, *Model studies, *Nutrient transport, *Path of pollutants, *Phosphorus, Computer models, Lake Veluwe, Mineralization, The Netherlands.

SED is a dynamic model describing the release of phosphorus from sediments in shallow, eutrophic lakes. The model includes only three state-variables (dissolved and organic particulate phosphorus, active sediment layer), simple relationships between the variables and a restricted number of parameters. In addition, the diffusive transport of dissolved phosphorus to the overlying water, mineralization of organic phosphorus in the sediment and adsorption/desorption and fixation of inorganic phosphorus can be examined. The model solves the differential equations for organic phosphorus and dissolved inorganic phosphorus in the sediments analytically; the calculation time step is one day. The use of one active layer, with a variable thickness between the aerobic zone and the layer subject to turbation, and the concept of coupling inorganic processes to mineralization results in a relative simple model structure. Calibration was performed with data sets of the shallow Lake Veluwe, The Netherlands. SED is capable of reproducing phosphorus retention in Lake Veluwe and yields realistic values for the net phosphorus release from the sediment, both in magnitude and in seasonal pattern. The change in external loading resulted in a significant decrease of retention and release. (Author's abstract)
W91-12859

FATE AND SHORT-TERM PERSISTENCE OF PERMETHRIN INSECTICIDE INJECTED IN A NORTHERN ONTARIO (CANADA) HEADWATER STREAM.
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
K. M. S. Sundaram.
Pesticide Science PSSCBG, Vol. 31, No. 3, p 281-294, 1991. 1 fig, 6 tab, 26 ref.

Descriptors: *Fate of pollutants, *Headwaters, *Path of pollutants, *Permethrins, *Pesticides, Aquatic habitats, Aquatic insects, Aquatic plants, Canada, Crustaceans, Detritus, Fish, Ontario, Pesticide residues, Sediment analysis, Sinks, Water analysis.

In 1987, the mobility, fate and short-term persistence of permethrin in some aquatic substrates were studied in a fast-flowing, cold-water forest stream in the Lake Superior watershed, following manual injection. 1.275 cubic dm of a 1.3 g/cu-dm aqueous emulsion of permethrin (i.e. 1.658 g permethrin) was applied to the surface of the fast-flowing stream by manual injection. Water samples were collected from the top 1-cm layer at different intervals of time at various distances downstream from the site of application. Caged samples of stream detritus, crayfish, brook trout, stonefly nymphs, bottled sediment and potted aquatic plants were placed 280 m from the treatment site, and collected afterward for residue analysis. The downstream movement of the chemical was not uniform with peak concentrations of about 12 ng/mL at 30 m, and 0.1 ng/mL at 730 m from the treatment site. The peak concentrations (ng/g) were in 18 potted aquatic plants, 39 in caged detritus, 14 in crayfish and 11 in brook trout; residues were higher than the ambient water concentration (1.67 ng/mL) and dissipated slowly. The peak concentration in bottled sediment was 2.75 ng/g, and the residues were lost rapidly. In contrast, the naturally occurring sediment in a beaver pond showed high residues that persisted for a longer period of time. Permethrin concentrations in invertebrate drift ranged from 9 to 357 ng/g, depending on the distance from the application site. The study demonstrated that aquatic invertebrates, plants and stream detritus acted as the major sink for the chemical. (Author's abstract)
W91-12868

EXPERIMENTAL ASSESSMENT OF PESTICIDE LEACHING USING UNDISTURBED LYSIMETERS.
Fraunhofer-Inst. fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.).
W. Kordel, M. Herrchen, and W. Klein.
Pesticide Science PSSCBG, Vol. 31, No. 3, p 337-348, 1991. 7 fig, 2 tab, 12 ref.

Descriptors: *Leaching, *Lysimeters, *Moisture meters, *Path of pollutants, *Pesticides, Absorption, Bentazone, Cloethocarb, Field tests, Groundwater pollution, Pesticide residues, Soil contamination.

Undisturbed lysimeters were treated with the pesticides bentazone and cloethocarb by hand spraying. Lysimeters and the surrounding area were planted and handled in the same way to avoid edge effects and to achieve a representative micro-climate comparable to field situations. It was is concluded that outdoor lysimeter experiments are integrated studies, which consider the comprehensive influence of environmental variables (such as soil type, and mode and rate of application) on the mobility and fate, in soil, of a chemical and its plant uptake, and give valid information on its potential for groundwater contamination. Although the prevailing 'environmental variables' such as sandy soil, high amount of precipitation and low annual average temperature of 7-3 C at a 10-cm soil depth represented a reasonable worst-case situation, bentazone was only leached in trace amounts and was metabolized relatively quickly. Metabolites could be detected in the leachate in concentrations never exceeding 0.02 microg/L. One was identified by high resolution MS as chlorobentazone. At the end of the study, less than 0-1% of the applied bentazone was extractable from the soil. A considerable amount of the applied radioactive material was still present in the soil and was characterized according to its extractability using different solvent systems. The major amount of radioactive material in the soil was extracted down to a depth of 80-90 cm using sodium hydroxide, and indicates incorporation of (14C) from the labelled active ingredient into soil organic matter of high molecular weight. It must be remembered that the results of lysimeter experiments are exactly valid only for identical climatic conditions and experimental design. However, extrapolation to other climatic conditions can be performed using mathematical simulation models such as SESOIL and PRZM. The interpretation of the studies has to consider: (1) that migration behavior under environmental conditions does not correspond with 'ideal chromatographic behavior' and (2) that lysimeter studies include the variables of field experiments and are not fully standardized. (Agostine-PTT)
W91-12869

DEVELOPMENT AND VALIDATION OF A MODIFIED FUGACITY MODEL OF PESTICIDE LEACHING FROM FARMLAND.
Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab.
D. Brooke, and P. Matthiessen.
Pesticide Science PSSCBG, Vol. 31, No. 3, p 349-361, 1991. 5 fig, 4 tab, 7 ref. DOE Contract PECD 7/8/117.

Descriptors: *Agricultural runoff, *Leaching, *Model studies, *Model testing, *Path of pollut-

ants, *Pesticides, Aquifers, Drains, Farms, Fugacity, Herbicides, Mecorop, Simazine, Simulation analysis, Soil contamination.

To test whether a simple model could provide reasonable quantitative estimates of chemical concentrations in a dynamic situation, Mackay's fugacity model was adapted to represent an agricultural field. The intention was to determine the extent of modification required to obtain reasonable agreement with experimental results, or indeed if such agreement could be achieved. The validity of the model was tested at Rosemaund Experimental Husbandry Farm in Herefordshire, where chemical input and output could be monitored, and meteorological and other parameters could be measured regularly. Concentrations of the two pesticides mecoprop and simazine were monitored at this site over a two year period. The work described is preliminary, and although it showed that the modified fugacity model predicts concentrations of the two herbicides, in soil, with reasonable accuracy, concentrations in drain and stream water were over-estimated. This was thought to be because pesticide-bearing water migrated past the field drains into the lower soil layers or aquifers. If significant fluxes of pesticide not found below the level of the field drains, a major re-appraisal of the modelling approach may be required. However, the fact that peak concentrations only persist for short periods, and this must be taken into account when conducting pesticide hazard evaluations. (Agostine-PTT)
W91-12870

LYSIMETER STUDIES.
Schering Agrochemicals Ltd., Essex (England).
C. R. Leake.
Pesticide Science PSSCBG, Vol. 31, No. 3, p 363-373, 1991. 3 fig, 4 tab, 12 ref.

Descriptors: *Analytical methods, *Fate of pollutants, *Leaching, *Lysimeters, *Moisture meters, *Path of pollutants, Benazolin, Carbon dioxide, Degradation products, Field tests, Groundwater pollution, Metabolites, Mineralization, Soil organic matter, Soil properties, Soil types.

In soil the herbicide benazolin-ethyl (ethyl 4-chloro-2,3-dihydro-2-oxo-1,3-benzothiazol-3-ylacetate) is degraded rapidly to the corresponding acid, which is further degraded to 4-chloro-1,3-benzothiazolin-2-one. Following ring opening, the latter is subsequently mineralized to carbon dioxide. Initial investigations using laboratory techniques showed that the acid, benazolin, was mobile in a variety of soil types, especially sandy soils with low organic matter contents. Lysimeters were used in a study of benazolin-ethyl, to more realistically investigate the degradation and leaching characteristics of benazolin-ethyl and its metabolites. Outdoor lysimeter studies using intact soil cores were found to provide a more realistic assessment of the potential of xenobiotics to contaminate groundwater than laboratory studies, without the usual complications and uncertainties of field studies. Specific advantages of lysimeters include: (1) the complete collection of leachate, (2) the ability to use radiochemicals, (3) the opportunity to use natural rainfall, with or without supplementary watering regimes, to simulate different climatic conditions; and (4) the ability to select different planting regimes and to compare the influence of soil type. Results of the experiments with benazolin-ethyl showed that, in contrast to laboratory studies where benazolin was detected in the leachate, in lysimeters the herbicide and its metabolite are preferentially degraded rather than leached, even in sandy soil types. (Agostine-PTT)
W91-12871

SENSITIVITY ANALYSIS OF A MATHEMATICAL MODEL FOR PESTICIDE LEACHING TO GROUNDWATER.
Winand Staring Centre for Integrated Land, Soil and Water Research, Wageningen (Netherlands).
J. J. T. I. Boesten.
Pesticide Science PSSCBG, Vol. 31, No. 3, p 375-388, 1991. 7 fig, 25 ref.

Descriptors: *Groundwater pollution, *Leaching, *Mathematical models, *Nonpoint pollution sources, *Path of pollutants, *Pesticides, *Sensitivity analysis, Dispersion, Kinetics, Seasonal variation, Soil properties, Soil types, Sorption, Temperature, Weather.

The sensitivity of pesticide leaching to pesticide/soil properties and to meteorological conditions, was assessed by calculations which use an existing convection-dispersion model. The model assumes equilibrium sorption (Freundlich equation), first-order transformation kinetics and passive plant uptake. The extent of pesticide leaching was characterized by the percentage of the dose leached below 1 m depth. The calculations were carried out for a humic sand soil cropped with maize and exposed to Dutch weather conditions. In general, the percentage leached was found to be very sensitive to the separation coefficient, the Freundlich exponent (describing the curvature of the isotherm), and the transformation rate. The percentage leached was moderately sensitive to weather conditions (wet/dry years), long-term sorption equilibration and the relationship between transformation rate and temperature. Sensitivity to the extent of plant uptake was only significant for pesticides with low sorption coefficients. Sensitivity to soil hydraulic properties was small. The effect of applying the pesticide in autumn instead of in spring was found to be very large for non-sorbing pesticides with short half-lives. The sensitivity to spatial variability in sorption coefficient and transformation rate was found to be substantial at the low percentages leached. (Author's abstract)
W91-12872

APPLICATION AND VALIDATION OF PESTICIDE LEACHING MODELS.
Fraunhofer-Inst. fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.).
M. Klein.
Pesticide Science PSSCBG, Vol. 31, No. 3, p 389-398, 1991. 4 fig, 7 tab, 5 ref.

Descriptors: *Leaching, *Lysimeters, *Mathematical models, *Model studies, *Path of pollutants, *Pesticides, Bentazone, Climates, Cloethocarb, Insecticides, Moisture meters, Simulation analysis, Sorption.

Two lysimeter studies with the pesticides cloethocarb and bentazone were used to validate a modified version of the computer model SESOIL (Seasonal Soil Compartment Model), and to transfer the results of the lysimeter study to another climate scenario. For cloethocarb, an experimental insecticide without marked mobility in the soil (as indicated by the lysimeter study), the simulations were in excellent agreement with the lysimeter study. Calculations obtained with SESOIL, for bentazone revealed higher leaching values than those found in the lysimeter study. This discrepancy was resolved by a more careful and realistic inclusion of lysimter soil sorption into the simulation model. (Author's abstract)
W91-12873

URBAN RUNOFF EFFECTS ON OHIO RIVER WATER QUALITY.
Ohio River Valley Water Sanitation Commission, Cincinnati.
C. G. Norman.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 44-46, June 1991. 4 tab.

Descriptors: *Nonpoint pollution sources, *Ohio River, *Path of pollutants, *Urban runoff, *Water pollution sources, Bioaccumulation, Chlorinated hydrocarbon insecticides, Fish, Heavy metals, Pesticides, Polychlorinated biphenyls, Tissue analysis, Water pollution effects, Water quality, Water quality monitoring.

Water quality assessments conducted by the Ohio River Valley Water Sanitation Commission (ORSANCO) show that nonpoint sources contribute pollutants to the Ohio River main stem and have, in some cases, impaired the designated uses of the river. A comparison of the pollution contribution from point sources and flowing sources revealed that concentrations from the latter are greater. ORSANCO found further that urban runoff is a significant nonpoint source. In 1983, the U.S. Environmental Protection Agency (EPA) studied the quality of urban runoff and the extent of its impact on surface waters. A manual monitoring system was established to assess ambient water quality conditions and evaluate trends. Fish tissue samples were collected to determine the presence of compounds that bioaccumulate, such as pesticides, but that cannot be detected in the water column because concentrations are usually too low. Relationships between pollution concentrations and flow were established and EPA found that urban runoff containing metals such as lead, zinc, copper, chromium, arsenic, cadmium, nickel, antimony, and selenium and heavy organics flows into the Ohio River. Results of fish tissue analyses indicated that urban runoff contributed polychlorinated biphenyls and chlordane in amounts exceeding fish tissue criteria used to regulate interstate commerce. Based on these data, five states (Pennsylvania, Ohio, West Virginia, Kentucky, and Indiana) issued advisories against consumption of certain fish taken from the Ohio River. (Agostine-PTT)
W91-12878

APPLYING URBAN RUNOFF MODELS.
Syracuse Univ., NY. Dept. of Civil and Environmental Engineering.
S. J. Nix.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 47-49, June 1991. 1 tab, 3 fig.

Descriptors: *Mathematical models, *Model studies, *Nonpoint pollution sources, *Urban hydrology, *Urban runoff, *Water pollution sources, *Water quality management, Calibrations, Design criteria, Management planning, Path of pollutants, Project planning.

Urban watersheds are complex flow systems sensitive to the dynamics of precipitation and pollutant loads from various sources. Deterministic mathematical models can simulate these dynamic interactions, including urban runoff and the associated pollutant loads. The model user may develop an in-house model or use one of the many off-the-shelf models available. Ideally, the selection of a model should be based on a careful analysis of benefits and costs. The more complex a model, the more information it produces. However, the associated cost of that information is rising rapidly from increased input data and personnel requirements. Prior to use, credibility of a model should be established by the processes of verification and validation. Verification involves examining a model's components to see if they perform as expected and learning the model's idiosyncracies. Validation refers to the process of data collection and calibration of the model parameters. The question of whether a modeling study should focus on a single design event; multiple, but discrete, design events; or on a continuous series of events, is complex. In general, however, continuous simulation is best suited for screening purposes and preliminary assessment, whereas multiple-event and single-event simulations are best suited for the analysis of design conditions. Models can be helpful in understanding, projecting, and abating nonpoint source problems. However, modeling must be part of an integrated attack on a problem, not its focus. (Agostine-PTT)
W91-12879

MINING-RELATED NONPOINT-SOURCE POLLUTION.
Colorado School of Mines, Golden. Dept. of Environmental Sciences and Engineering Ecology.
For primary bibliographic entry see Field 5G.
W91-12880

RESEARCH NEEDS FOR NONPOINT SOURCE IMPACTS.
CH2M Hill, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5B.
W91-12881

RESEARCH NEEDS FOR NONPOINT SOURCE IMPACTS.

CH2M Hill, Inc., Gainesville, FL.
M. Griffin, W. Kreutzberger, and P. Binney.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 60-64, June 1991. 2 fig.

Descriptors: *Nonpoint pollution sources, *Path of pollutants, *Research priorities, *Water pollution control, *Water pollution sources, Aquatic habitats, Calibrations, Model studies, Polycyclic aromatic hydrocarbons, Water pollution effects, Water resources institutes.

Despite near achievement of Clean Water Act goals, water quality problems persist and the primary cause of pollution from nonpoint sources (NPS): diffuse sources associated with land and its use. Several related topics have been identified as most in need of research, and a cooperative research program to assess the current state of NPS pollution has been established, based on a review of literature. A recent report described the literature review of NPS pollution effects on aquatic habitats, and identified where further knowledge was required to predict nonpoint sources of pollution. The report also suggested research topics to improve NPS pollution technology. The ten highest-priority projects selected for consideration were: (1) preparing effective and implementable NPS regulations; (2) developing a program to identify and evaluate use-attainability methodologies; (3) identifying a representative and cost-effective sampling protocol for NPS; (4) describing riparian buffer zone function and effectiveness; (5) determining the effect of time scale of discharge on acute and chronic toxicity in different ecosystems; (6) identifying processes that define sediment toxicity interactions in different ecosystems; (7) documenting nonstructural controls to reducing NPS pollution; (8) establishing a framework for model selection, application, calibration, and validation; (9) understanding impacts of snowmelt NPS on receiving waters; and (10) determining decomposition rates for various polyaromatic hydrocarbons in both aerobic and anaerobic conditions. (Agostine-PTT)
W91-12881

VERTICAL FLUXES OF VOLATILE MERCURY OVER FOREST SOIL AND LAKE SURFACES IN SWEDEN.
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Inorganic Chemistry.
Z. F. Xiao, J. Munthe, W. H. Schroeder, and O. Lindqvist.
Tellus TELLAL, Vol. 43, No. B3, p 267-279, July 1991. 8 fig, 3 tab, 47 ref.

Descriptors: *Fluctuations, *Forest soils, *Mercury, *Path of pollutants, *Sweden, Air pollution, Forest watersheds, Water temperature.

A flux chamber technique applied to volatile mercury species was developed to measure the direction and magnitude of mercury transfer between the atmosphere and lake or soil surfaces. Measurements were performed over four oligotrophic forest lakes in southwestern Sweden during 1988 and 1989. Net emission fluxes of mercury were measured from the lakes. The measured daytime fluxes during the warmer season (water temperature 13-23 C) were within the range of 3-20 ng/hr/sq m (average 7.9 ng/h/sq m). The average nighttime fluxes measured during the same season were 2 to 3 times smaller. Two sets of measurements, performed during the winter when water temperatures were </= 2 C, gave flux values close to zero. Flux measurements were also performed over soil in a coniferous forest. Compared to the situation for the forest lakes, the fluxes of mercury over forest soil are much lower in magnitude, with values ranging from approximately -2 to +2 ng/hr/sq m during different seasons. Emission was observed with an average of 0.3 ng/h/sq m when soil temperature was about 10 C, while dry deposition was measured with an average of 0.9 ng/h/sq m, when soil temperature was < 3 C. (Author's abstract)
W91-12901

SCAVENGING OF TWO DIFFERENT TYPES OF MARINE AEROSOL PARTICLES CALCULATED USING A TWO-DIMENSIONAL DETAILED CLOUD MODEL.
Mainz Univ. (Germany, F.R.). Inst. for Atmospheric Physics.
For primary bibliographic entry see Field 2B.
W91-12903

MICROBIAL CONTAMINATION AS AN INDICATOR OF SEWER LEAKAGE.
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
H. Dizer, and U. Hagendorf.
Water Research WATRAG, Vol. 25, No. 7, p 791-796, July 1991. 5 fig, 16 ref.

Descriptors: *Bioindicators, *Leakage, *Microbiological studies, *Path of pollutants, *Sewers, *Water pollution sources, Actinomycetes, Bacteria, Fungi, Organic carbon, Soil contamination, Wastewater disposal.

The presence of several physiological groups of microorganisms (general aerobic bacteria, amylolytic bacteria, denitrifying bacteria, actinomycetes and fungi) was investigated in wastewater, seepage water, and soil samples in areas of sewer leakage. The results were compared with the findings for several chemical parameters (pH value, electrical conductivity, and total organic carbon (TOC)) analyzed. Wastewater infiltration causes an increase in the TOC concentration of seepage water samples. In the same samples, an increase in general aerobic bacteria and denitrifying bacteria was recorded. General aerobic bacteria, actinomycetes, and fungi were more abundant in contaminated soil samples than in non-contaminated ones. The occurrence of denitrifying bacteria and amylolytic bacteria in the soil samples did not show correlations to sewer leaks. The relationship between results from the chemical and microbiological analyses not only indicates contamination of seepage water and soil due to wastewater exfiltraiion, but also provides information on the degradation potential of microorganisms and a part of this decomposition process in the underground. Knowledge of the occurrence of various physiological groups of microorganisms is of extraordinary importance for classifying and judging the level of contamination, as well as for choosing a renovation process. In an epidemiological view, the bacteria and viruses pathogenic to humans should be considered in the case of wastewater exfiltration near drinking water supplies. (Author's abstract)
W91-12908

TRIHALOMETHANE FORMATION IN CHLORINATED DRINKING WATER: A KINETIC MODEL.
Hebrew Univ. of Jerusalem (Israel). Graduate School of Applie Science and Technology.
For primary bibliographic entry see Field 5F.
W91-12909

AQUEOUS GEOCHEMISTRY OF CHROMIUM: A REVIEW.
Bureau de Recherches Geologiques et Minieres, Orleans (France). Geochemistry Dept.
For primary bibliographic entry see Field 2K.
W91-12910

DETERMINATION OF RHODAMINE WT IN SURFACE WATER BY SOLID-PHASE EXTRACTION AND HPLC WITH FLUORESCENCE DETECTION.
Ministry of Transport and Public Works, Middelburg (Netherlands). Tidal Waters Div.
For primary bibliographic entry see Field 2K.
W91-12919

MODELLING OF BOD EXERTION CURVE.
Roorkee Univ. (India). Dept. of Civil Engineering.
P. K. Swamee, and C. S. P. Ojha.
Water Research WATRAG, Vol. 25, No. 7, p 901-902, July 1991. 1 ref.

Descriptors: *Biochemical oxygen demand, *Mathematical models, *Model studies, *Path of pollutants, Biochemistry, Graphical analysis, Kinetics, Mathematical analysis, Mathematical equations, Nitrogen.

The biochemical oxygen demand (BOD) exertion phenomenon, being a result of complex biochemical reactions between the heterogeneous assemblage of biota and the complex organic substrate, shows a lag phase, followed by a rising curve terminated at a plateau, and again a saturating type increasing curve yielding an ultimate carbonaceous BOD. For the substrate rich in nitrogenous compounds, there is a further increase in the BOD curve, saturating at the second state ultimate BOD value. The BOD kinetics models in vogue describe a particular phase or stage only, and lack in general applicability over the entire exertion process. A generalized BOD exertion equation is presented which is valid over all the phases and stages of the phenomenon. (Author's abstract)
W91-12921

DISSIPATION OF RESIDUES OF 2,4-D IN WATER, HYDROSOIL AND FISH.
Fish and Wildlife Service, Warm Springs, GA. Fish Pesticide Research Lab.
D. P. Schultz, and E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 122-127, 1 tab, 6 ref.

Descriptors: *Aquatic weed control, *Fate of pollutants, *Path of pollutants, *Pesticide residues, *Phenoxy acid herbicides, Aquatic soils, Fish, Florida, Georgia, Water analysis, Water hyacinth, Water milfoil.

Eurasian watermilfoil and waterhyacinth can be controlled by the use of phenoxy herbicides. The effects of these herbicides on the aquatic environment have been studied but not fully examined for cause and effect in the field. A field study was conducted to determine the uptake and dissipation of the dimethylamine salt of (2,4-dichlorophenoxy) acetic acid (2,4-D) in water, hydrosoil, and fish in ponds located in Florida and Georgia. The ponds were treated at 2, 4, and 8 lbs per acre, the equivalent of one-half, one, and two times the recommended treatment rate. The highest amount of 2,4-D residue in Florida pond water was 0.345 mg/L found 3 days after treatment in the pond treated with 8 lbs per acre. Residues decreased to 0.005 mg/L within 14 days of treatment. In Georgia, where the ponds were treated at a slightly higher level only trace levels or no residues were detected at 14 days. Highest levels of 2,4 D found in the hydrosoils of Florida and Georgia were between 0.042 and 0.046 mg/kg between 3 and 7 days after treatment. The dissipation of 2,4-D is due in great measure to microbial degradation. Only negligible residues were found in fish. The effect of 2,4-D application on waterhyacinth was assessed by visual observation. Seven days after spraying, nearly all of the waterhyacinth in all ponds were brown and decomposing. An estimated 98% of the plants were killed by herbicide application, with no differences in kill noted among the different treatment levels. Since all three treatment levels were equally effective, it is recommended to use the lowest effective concentration. (See also W91-12922) (Doyle-PTT)
W91-12933

DISSIPATION OF 2,4-D RESIDUES IN LARGE RESERVOIRS.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 128-134, 3 tab, 11 ref.

Descriptors: *Aquatic weed control, *Fate of pollutants, *Path of pollutants, *Pesticides residues, *Phenoxy acid herbicides, *Reservoirs, Introduced species, Regression analysis, Submerged plants, Water milfoil.

Eurasian watermilfoil, an old world, rooted, submersed plant has become a most troublesome aquatic weed. Due to its rapid rates of growth, fragmentation, migration, and establishment, it has

depressed real estate values, hindered recreational activities, clogged municipal water supply intakes, provided extensive breeding grounds for mosquitoes, and interfered with small boat navigation and commercial fishing. The most effective and economical method of controlling Eurasian watermilfoil is treatment with the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D). To describe representative reservoirs according to the characteristics which influence the levels, movement, and persistence of residues of 2,4-D, residue data gathered by standard chemical analysis of water samples, for reservoirs in British Columbia and by the Tennessee Valley Authority, Corps of Engineers, and Bureau of Reclamation were subjected to stepwise multiple regression analysis. Three descriptive factors were chosen: (1) volume of the water system, selected as an index for dilution effects, (2) mean depth, as a crude index of susceptibility to rooted aquatic weed infestation, and therefore, to potential extent of herbicide application, and (3) mean length of growing season, an index of temperature effects on herbicidal residue degradation. Results of this study showed that season, volume, and rate were highly significant. The depth of the reservoir and time after application (days) were not significant, that is, they were adequately measured by the above variables. The standard application rate of 20-40 lbs/acre did not produce residues in large reservoirs above the tolerance level of 100 ppb. (See also W91-12922) (Doyle-PTT)
W91-12934

5C. Effects Of Pollution

SPECIES COMPOSITION AND DYNAMICS OF THE PHYTOPLANKTON IN A RECENTLY-COMMISSIONED RESERVOIR (AZIBO, PORTUGAL).

Porto Univ. (Portugal). Inst. de Zoology.
For primary bibliographic entry see Field 2H.
W91-11618

RESPONSE OF MACROINVERTEBRATES TO LOW PH AND INCREASED ALUMINIUM CONCENTRATIONS IN WELSH STREAMS: MULTIPLE EPISODES AND CHRONIC EXPOSURE.

National Rivers Authority, Cardiff (Wales).
W. J. Merrett, G. P. Rutt, N. S. Weatherley, S. P. Thomas, and S. J. Ormerod.
Archiv fuer Hydrobiologie AHYBA4, Vol. 121, No. 1, p 115-125, March 1991. 2 fig, 4 tab, 23 ref. Department of The Environment contract no. PECD 7/10/73.

Descriptors: *Acid rain effects, *Acidification, *Aluminum, *Macroinvertebrates, *Streams, *Toxicity, *Water pollution effects, Field studies, Hydrogen ion concentration, Mortality, Sulfates.

Field investigations were undertaken in order to assess the relative effects of chronic and episodic acidification on freshwater ecosystems. The mortality of invertebrates exposed for up to 29 days in Welsh streams of differing acidity (mean pH 4.8-7.0) was studied. Caged invertebrates and the indigenous fauna of a circumneutral stream were also exposed to a series of simulated acid episodes by adding sulfuric acid and aluminum sulfate for three 24-h periods (mean pH 4.8-5.3, 0.45-micron filterable aluminum, 0.36-0.85 mg/L) separated by two 12-h intervals (pH 7.1-7.3, 0.04-0.08 mg Al/L). An upstream reach provided reference conditions. Invertebrates were exposed for varying periods (6, 12, 18, 24-h) within episodes and for different combinations of the three episodes. The drift of naturally occurring invertebrates was monitored throughout the experiment. In long term exposures, mortalities of the ephemeropterans Baetis rhodani and Rhithrogena semicolorata were highest in streams of low mean pH and high aluminum concentrations. By contrast, the mortality of the plecopteran Amphinemura sulcicollis was unrelated to acidity. In simulated episodes, A. sulcicollis and the trichopteran Hydropsyche instabilis exhibited high survival. Mortalities of B. rhodani and R. semicolorata exposed to three 6 or 12-h episodes were low, mortality increasing only when the duration of episodes increased to 18 or 24-h. Multiple exposures of these durations had cumulative effects. Drift of Baetidae and Heptageniidae was enhanced during episodes, resulting in a greatly reduced relative abundance of B. rhodani in the benthos. (Author's abstract)
W91-11620

IMPACT OF HUMAN ACTIVITY ON MARINE HABITATS ALONG THE RED SEA COAST OF SAUDI ARABIA.

Alexandria Univ. (Egypt). Dept. of Oceanography.
A. A. Aleem.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 7-15, December 1990. 2 fig, 13 ref.

Descriptors: *Coastal areas, *Lagoons, *Path of pollutants, *Red Sea, *Saudi Arabia, *Sea grasses, *Water pollution effects, Algal blooms, Corals, Cyanophyta, Desalination plants, Fisheries, Human population, Jeddah coast, Mortality, Species diversity, Thermal pollution.

Transgression on marine habitats (seagrass beds, coral reefs and mangrove stands) along the Jeddah coast and adjacent lagoons, owing to increased human activity, resulted in regression, degeneration or substitution of plant and animal communities. Observations were made on marine habitats on the Jeddah coast of Saudi Arabia for a number of years both before and after the perturbation of these habitats by dumping sediments, stones and boulders, or by dredging of the sea bottom for coastal engineering projects and other types of construction. Pollution from increased human activity at Obhor Creek endangers delicate or sensitive species of both plant and animals, as well as affecting fishery resources. Avicennia marina stands are adversely affected near the recreation centers at Shu'aiba lagoons. Coral reef fauna showed increased mortality and degeneration on the narrow reef flats at Obhor. Corals on the reef edge and crest showed signs of recovery. Recolonization of stony corals is a slow and unpredictable process. Regression of corals in the back reef at Obhor was accompanied by a measurable decline in the animal diversity. Thermal pollution in the vicinity of the desalination plant at Jeddah caused a decrease in overall algal species diversity and reductions in habitat availability, while the blue-green alga Microcoleus, in contrast, increased greatly in population size. Baseline studies on marine habitats should be continued for a better understanding of such critical habitats. (Brunone-PTT)
W91-11621

WATER QUALITY AND PLANKTON PERIODICITY IN TWO CONTRASTING MINE LAKES IN JOS, NIGERIA.

Jos Univ. (Nigeria). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-11622

COMPARATIVE ECOLOGY OF ESTUARIES IN NIGERIA.

Nigerian Inst. for Oceanography and Marine Research, Lagos.
For primary bibliographic entry see Field 2L.
W91-11623

LIKELY EFFECTS OF SALINITY ON ACUTE COPPER TOXICITY TO THE FISHERIES OF THE LAKE GEORGE-EDWARD BASIN.

Uganda Freshwater Fisheries Research Organization, Jinja.
F. W. B. Bugenyi, and A. J. Lutalo-Bosa.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 39-44, December 1990. 2 fig, 4 tab, 25 ref.

Descriptors: *Copper, *East Africa, *Fisheries, *Heavy metals, *Limnology, *Salinity, *Toxicity, *Toxicology, *Water pollution effects, Adsorption, Alkalinity, Fish populations, Lake George-Edward basin, Organic compounds, Precipitation, Trace minerals, Uganda, Western Rift Valley.

Alkaline, saline waters are common in the Western Rift Valley of East Africa, in which the lake George-Edward basin is situated. A growing copper mining industry in the area creates a need to understand the limnology of the lakes in the basin before copper pollution occurs. The fish could possibly suffer from acute (or chronic) toxicity if copper levels increase. Abiotic factors within the alkaline, saline waters of the basin reduce the acute toxic effects of copper to fish. The most important factor is salinity, which is a measure of the total dissolved mineral salts. The relatively high concentrations of mineral salts of these waters will reduce the effective copper ionic activity through adsorption, precipitation and ionic interference. The high concentrations of organic compounds in the water also complex and chelate the ionic copper, thus further reducing effective concentration, and acting as a check on the copper toxicity to the fish of the lake basin. (Author's abstract)
W91-11624

MASSIVE FISH KILLS WITHIN THE NYANZA GULF OF LAKE VICTORIA, KENYA.

Kenya Marine and Fisheries Research Inst., Kisumu. Kisumu Lab.
P. B. O. Ochumba.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 93-99, December 1990. 3 fig, 3 tab, 35 ref.

Descriptors: *Enrichment, *Fishkill, *Kenya, *Lake Victoria, *Lake fisheries, *Lake morphometry, *Nyanza Gulf, *Path of pollutants, *Precipitation, *Water pollution effects, Algal blooms, Bacteria, Commercial fishing, Hydrogen ion concentration, Mortality, Nutrient concentrations, Population density, Runoff, Sediment load, Suspended sediments, Water level.

The morphometry and hydrology of the Nyanza Gulf of Lake Victoria can be greatly affected by violent storms, often resulting in a condition in which nutrient-rich bottom mud is mixed with the sediment-laden runoff water from neighboring marshes and rivers. This situation can lead to massive fish kills. Such an event in 1984 caused the sudden death of over 400,000 fish weighing over 2400 tons. The unusually low precipitation in the catchment area during that year resulted in a drop in the lake level from 12.4 to 11.8 m. This low water level, combined with a severe storm created the conditions which caused this large fish kill. The species affected were Lates niloticus and Oreochromis niloticus. Mortality was attributed to several factors, including high levels of suspended material in the water column (detritus and algae) which clogged the gills of the fish, low dissolved oxygen, low pH (an indicator of the presence of carbon dioxide produced by bacterial metabolism), and high concentrations of algae. Algal blooms and dead fish within the Gulf are clear indications of the severity of pollution by organic matter and nutrients from the drainage area. The consequences of continued fish kills will be twofold. First, they are a public nuisance and an eyesore, making the lake unattractive for recreational activities and commercial fisheries. Secondly, if the kills occur more frequently and to a greater extent, they may reduce the brood stock to such an extent that future commercial fishing will be unproductive. (Brunone-PTT)
W91-11629

PHYTOPLANKTON FLORA IN THE WARRI/FORCADOS ESTUARY OF SOUTHERN NIGERIA.

Benin Univ., Benin City (Nigeria). Dept. of Botany.
F. I. Opute.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 101-109, December 1990. 3 fig, 35 ref. University of Benin Senate Research Grant No. 60/434.

Descriptors: *Algal blooms, *Estuaries, *Estuarine environment, *Eutrophication, *Nigeria, *Nuisance algae, *Phytoplankton, *Saline-freshwater interfaces, *Species composition, *Warri/Forcados Estuary, *Water pollution effects, Brackish water, Chlorophyta, Cyanophyta, Diatoms, Dinoflagellates, Distribution patterns, Euglenophyta, Runoff, Salinity, Stream discharge, Tidal effects.

The phytoplankton flora of the Warri/Forcados estuary varied from typical fresh and brackish water forms to purely distinct marine species. These communities were made up of members of the Bacillariophyta (about 80 species), Chlorophyta (over 90 species), Cyanophyta (16 species), Dinophyceae (10 species) and the Euglenophyta (8 species). The bulk of the species belonging to the Chlorophyta, Cyanophyta, and the Euglenophyta were almost exclusively freshwater in distribution, being limited to habitats of less than 0.5 ppt salinity. Members of the Bacillariophyta were found in all habitats, occurring freely in freshwater, estuarine and marine ecosystems. In all cases, no true examples of euryhalinity were recorded. The majority of dinoflagellates encountered, as well as a number of marine diatoms, manifested stenohaline peculiarities as they could not tolerate a wide salinity range. The overall influence of the periodic shift in salinity and some physicochemical parameters along the stretch of the estuary brought about by strong tidal effects and the variable seasonal volume of water discharge or runoff affects the pattern and limit of distribution of phytoplankton species. The relatively high amount of phytoplankton in the estuary is a manifestation of the level of eutrophication. Oligohaline regions (0-5 ppt) can be sites of blue-green algal blooms, while dinoflagellates tend to dominate as nuisance taxa at salinities in excess of 5 ppt. In this study, taxa belonging to both groups of phytoplankton (e.g., Microcystis, Coelospharium, Gonyaulax, Gymnodinium) were frequently encountered. (Brunone-PTT)
W91-11630

ACID SENSITIVITY AND WATER CHEMISTRY CORRELATES OF AMPHIBIAN BREEDING PONDS IN NORTHERN WISCONSIN, USA.
Iowa State Univ., Ames. Dept. of Animal Ecology.
F. J. Kutka, and M. D. Bachmann.
Hydrobiologia HYDRB8, Vol. 208, No. 3, p 153-160, December 10, 1990. 1 fig, 2 tab, 24 ref.

Descriptors: *Acid rain, *Acid rain effects, *Acidification, *Amphibians, *Hydrogen ion concentration, *Ponds, *Water chemistry, *Water pollution effects, *Wisconsin, Forests, Frogs, Path of pollutants, Phenolics, Salamanders, Soil types, Toads, Toxicity.

Temporary ponds across northeastern North America appear to be sensitive to continued acid deposition because they depend on rain and snowmelt for most of their water. Amphibians breeding in these waters may be at risk to low pH levels. Fifty-one amphibian breeding sites in northern Wisconsin were sampled in two surveys, in 1986 and 1987, to determine the chemical conditions and amphibian inhabitants present. All twenty-one ponds in 1986 and 28 in 1987 were mildly acidic and sensitive to acidification. The pH levels encountered were generally not toxic to the resident amphibians, and may have been related to levels of phenolics in some cases. Soil type and forest canopy coverage appeared to influence the chemistry of these ponds and a direct relationship of amphibian species richness with pond size was found. Only larger ponds were long-lived enough for metamorphosis of amphibian larvae, suggesting an importance for recruitment. They were also the most sensitive ponds and the only ones to enter the chronically toxic pH range for ambystomatid salamanders, possibly placing them at risk to future acid inputs. Calcium levels were low enough in most ponds that no alleviation of pH lethality to ambystomatid embryos is likely should pH levels drop. (Brunone-PTT)
W91-11633

RESPONSES OF A EUTROPHIC POND COMMUNITY TO SEPARATE AND COMBINED EFFECTS OF N:P SUPPLY AND PLANKTIVOROUS FISH: A MESOCOSM EXPERIMENT.
Texas Christian Univ., Fort Worth. Dept. of Biology.
R. W. Drenner, J. D. Smith, J. R. Mummer, and H. F. Lancaster.
Hydrobiologia HYDRB8, Vol. 208, No. 3, p 161-167, December 10, 1990. 2 fig, 1 tab, 30 ref. TCU Research Fund Grants 5-23717 and 5-23723.

Descriptors: *Eutrophic lakes, *Fish populations, *Food chains, *Lake restoration, *Limiting nutrients, *Limnology, *Nitrogen, *Nutrients, *Phosphorus, *Plankton, *Species composition, *Water pollution effects, Bluegills, Chlorophyll, Chlorophyta, Copepods, Cyanophyta, Diatoms, Midges, Phytoplankton, Rotifers, Transparency, Turbidity, Waterfleas.

An outdoor mesocosm experiment of factorial design consisting of three levels of nutrient supply (no nutrient addition and additions of nitrogen and phosphorus in ratios of 10:1 and 45:1) cross-classified with two levels of bluegill (Lepomis macrochirus) (presence and absence) was conducted at Texas Christian University. Nutrient supply significantly affected total phosphorus (TP), total nitrogen (TN), TN:TP ratio, turbidity, Secchi depth, phytoplankton, chlorophyll, filamentous blue-green algae, periphyton chlorophyll, Asplanchna and non-predatory rotifers. The presence of bluegill significantly increased TP, turbidity, diatoms, unicellular green algae, colonial blue-green algae, filamentous blue-green algae, periphyton chlorophyll, Asplanchna and non-predatory rotifers, and decreased Secchi depth, cladocerans, cyclopoid copepodids, copepod nauplii and chironomid tube densities. Nutrient supply and fish effects were not independent of each other as shown by significant nutrient-fish interaction effects for TP, Secchi depth, filamentous blue-green algae, periphyton chorophyll, Asplanchna and non-predatory rotifers. In eutrophic communities, nutrient reduction may be more effective than biomanipulation of fish and zooplankton communities. (Author's abstract)
W91-11634

BIOLOGICAL PROCESSES IN TWO BEECH FOREST SOILS TREATED WITH SIMULATED ACID RAIN: A LABORATORY EXPERIMENT WITH ISOTOMA TIGRINA (INSECTA, COLLEMBOLA).
Goettingen Univ. (Germany, F.R.). Zoologisches Inst. und Museum.
V. Wolters.
Soil Biology & Biochemistry SBIOAH, Vol. 23, No. 4, p 381-390, 1991. 4 fig, 2 tab, 56 ref.

Descriptors: *Acid rain effects, *Beech trees, *Forest soils, *Insects, *Litter, *Soil organisms, Ammonium, Biodegradation, Buffering, Carbon mineralization, Liming, Nitrates, Stemflow.

The effect of simulated acid rain on soil biotic processes was studied in a beech forest on moder soil using experimental chambers. Substrate from a limed area was included in order to analyze the influence of a modified state of base saturation on the reaction of soil organisms to acid rain. Water adjusted to pH 4.15 was applied to the control treatments to simulate proton deposition by precipitation, and water adjusted to pH 2.95 was applied to the acid rain treatments to simulate proton input by stemflow water. In the acid treated soil, CO2-C production, C mineralizaton of the litter colonizing microflora, microbial biomass in the F layer and leaching of nitrate-N were reduced, while the metabolic quotient of the F microflora as well as leaching of mineral-N were increased. The negative effect of acid rain on the early stage of litter decomposition was especially strong. After termination of the acid rain regime, the litter colonizing microflora responded rapidly and their 14CO2 production approached that of the controls within 3 weeks. Isotoma tigrina reduced C mineralization of the litter colonizing microflora, diminished the biomass and the metabolic quotient of the microflora in the F layer and accelerated the leaching of mineral-N in the pH 4.15 treatment of the natural soil. For many properties measured these effects were significantly different in the lime and in the pH 2.95 treatments. In the acid rain-treated natural soil, I. tigrina diminished the acid-induced leaching of mineral-N and accelerated the recovery of the litter colonizing microflora after acid rain had been terminated. The mesofauna may thus form an important part of the biological buffering system in the organic layer of acid soils. In the limed soil, the effect of acid rain on many of the properties measured was less pronounced than in the natural soil, suggesting that liming of acid forest soils increases the buffering capacity of biotic processes against acid stress. The buffering effect on the early stage of litter decomposition was diminished by the fact that in the limed soil, in contrast to the natural soil, the litter-colonizing microflora was not able to respond rapidly after termination of the acid rain regime. In contrast to its effect in the natural soil, I. tigrina did not accelerate recovery. (Author's abstract)
W91-11662

RELATIONSHIPS BETWEEN HEPATIC NEOPLASMS AND RELATED LESIONS AND EXPOSURE TO TOXIC CHEMICALS IN MARINE FISH FROM THE U. S. WEST COAST.
National Marine Fisheries Service, Seattle, WA. Northwest Fisheries Center.
M. S. Meyers, J. T. Landahl, M. M. Krahn, and B. B. McCain.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 7-15, 1991. 2 fig, 7 tab, 44 ref.

Descriptors: *Carcinogens, *Fish diseases, *Heavy metals, *Puget Sound, *Toxic wastes, *Toxicology, *Water pollution effects, Fish morphology, Fish physiology, Hydrocarbons, Marine environment, Organic compounds, Polycyclic aromatic hydrocarbons, Sediment contamination, Sole, Washington.

Results from field and laboratory studies investigating the etiology of hepatic neoplasms and other lesions involved in hepatic neoplasia in English sole, support a causal relationship between exposure to sediment-associated contaminants, primarily polycyclic aromatic hydrocarbons (PAH), and the development of these lesions. Evidence supporting this view include: (1) the construction of a model of the histogenesis of hepatic neoplasia in English sole that parallels the multistep neoplastic process demonstrated in experimental hepatocarcinogenesis models; (2) the development of a logistic regression model that accounts for about 35% of the variation in neoplasm prevalence in wild English sole, and attributes 12% of the total variation to levels of PAH's in sediment; (3) the creation of a separate logistic regression model showing significant increases in the probability of most hepatic lesions occurring in sole from contaminated sites and in older fish exposed to contaminants for longer periods; (4) the demonstration of significant positive correlations between fluorescent aromatic compound levels in bile, and the prevalence of hepatic lesion types in wild English sole; and (5) the experimental induction of unique hepatotoxic, regenerative and putatively preneoplastic focal lesions in English sole by repeated and extended exposure to a model hepatoxicant/hepatocarcinogen or a PAH-enriched extract of a contaminated sediment from a site in Puget Sound. Regardless of the significant progress achieved so far in elucidating aspects of the etiology of hepatic neoplasia in English sole, more research is needed on the multiple genetic and epigenetic factors and the mechanisms that are operant in the process of hepatic neoplasia in this species. (Feder-PTT)
W91-11663

NEOPLASMS AND NONNEOPLASTIC LIVER LESIONS IN WINTER FLOUNDER, PSEUDOPLEURONECTES AMERICANUS, FROM BOSTON HARBOR, MASSACHUSETTS.
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
R. A. Murchelano, and R. E. Wolke.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 17-26, 1991. 15 fig, 43 ref.

Descriptors: *Bioaccumulation, *Boston Harbor, *Cancer, *Fish diseases, *Flounders, *Wastewater pollution, *Water pollution effects, Carcinogens, Lesions, Liver, Massachusetts, Path of pollutants, Tissue analysis, Toxicity.

A variety of neoplasms and nonneoplastic hepatic lesions have been noted in winter flounder, Pseudopleuronectes americanus, from Boston Harbor, Massachusetts. Inflammatory lesions include cholangitis, pericholangitis, pericholangial fibrosis,

hepatitis and pancreatitis. Necrotic lesions consist essentially of focal coagulative necrosis and a distinctive acuolated cell lesion of the hepatic parenchyma. The most conspicuous and numerous proliferative lesion is macrophage aggregate hyperplasia and hypertrophy. Preneoplastic lesions principally include basophylic foci or cellular alteration and hepatocellular adenoma. Carcinomas consist of several morphologic varieties: hepatocarcinoma, cholangiocarcinoma, and anasplastic adenocarcinoma. The high prevalence of hepatic neoplasia in Boston Harbor winter flounder suggests a relationship to anthropogenic pollution. This study and prior studies reveal similar pathogenetic patterns: a progression from toxic necrotic lesions to neoplasia, further evidencing that pollutants are inducers of the lesions. Bottom-living food fish with enzootic neoplastic disease warrant further investigation, particularly with respect to the possible bioaccumulation of chemical contaminants in edible tissues. (Author's abstract)
W91-11664

CARCINOGENS AND CANCERS IN FRESHWATER FISHES.
Roswell Park Memorial Inst., Buffalo, NY.
J. J. Black, and P. C. Baumann.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 27-33, 1991. 4 tab, 65 ref.

Descriptors: *Bioaccumulation, *Cancer, *Fish diseases, *Great Lakes, *Neoplasms, *Water pollution effects, Bullhead, Copper, Food chains, Geographic distribution, Polychlorinated biphenyls, Public health, Sucker, Tissue analysis.

Fish neoplasia has recently received considerable emphasis as an early warning system for the detection of carcinogens in the aquatic environment. This idea is supported mosly by circumstantial evidence, though there is a growing body of field-related, laboratory-generated data, which also supports a link between certain kinds of aquatic pollution and cancer in fish. Neoplasms in fish can vary widely in their degree of cellular atypia and biologic behavior. Various kinds of neoplasms have been documented to occur in freshwater teleosts and the epizootiology of these diseases has recently been reviewed. Among the various freshwater species, brown bullheads and white suckers appear circumstantially to be highly sensitive sentinel animals. Both fish species are bottom feeders and, at one or more locations, have exhibited oral, epidermal, and hepatic neoplasms. White suckers from some Great Lakes sites, in particular, western Lake Ontario, have exhibited high frequencies of oral papillomas. Hepatic neoplasms of both cholangiocellular and hepatocellular origin also occur in white suckers. In brown bullheads, hepatic neoplasia, including hepatocellular and cholangiocellular types, have been observed to occur in bullheads from Deep Creek Lake, Maryland, the Fox River, IL, and, industrialized urban aquatic areas of eastern Lake Erie in the vicinity of Buffalo, NY. Although no known chemical carcinogens have been found in high concentrations, the sediments contain high concentrations of some metals, including Cr, Ni, Zn, and especially copper. Consumption rates of contaminated fish (mostly salmon) by humans and the transfer of PCBs, a potential causative agent of these effects, has been well documented in serum, cord blood, and breast milk. Recent studies of human health effects in relation to consumption of contaminated Great Lakes trout and salmon, have clearly shown that subtle neurological and growth deficits occurred in a dose-related fashion in exposed infants. New approaches to the problems of recognizing and measuring these subtle effects will be required. (Feder-PTT)
W91-11665

EPIZOOTIOLOGY AND DISTRIBUTION OF TRANSMISSIBLE SARCOMA IN MARYLAND SOFTSHELL CLAMS, MYA ARENARIA, 1984-1988.
National Marine Fisheries Service, Oxford, MD. Oxford Lab.
C. A. Farley, D. L. Plutschak, and R. F. Scott.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 35-41, 1991. 2 fig, 4 tab, 29 ref.

Descriptors: *Animal diseases, *Chesapeake Bay, *Clams, *Epizootiology, *Water pollution effects, Cancer, Carcinogens, Chlordane, Distribution patterns, Maryland, Mollusks, Regression analysis, Statistical analysis.

Epizootic manifestations of clam sarcoma (geographic spread, size versus prevalence) suggest that this is a transmissible disease. Data gathered from a seasonal and geographic study of sarcoma in Maryland softshell clams from 1984 to 1988, revealed a high (90%) incidence of epizootic occurrence in the sampling area. The disease first invaded populations of large adult clams, and then spread to the small juvenile clam population. An apparent two year cycle was noted with varying seasonal effects. Affected sites tended to be in the main stem of the Chesapeake Bay north of Tangier Sound, primarily in areas where the major harvesting occurs. However, several sites, mostly in upstream locations, were consistently free of disease. The epizootiological study supports the interpretation that the disease is infectious exclusively to this species. Regression analysis between sarcoma prevalence and contaminant levels in clam tissues showed a significant correlation (p=0.0001) between chlordane levels and this disease. No correlation was found with other analyzed contaminants. (Feder-PTT)
W91-11666

GERMINOMAS AND TERATOID SIPHON ANOMALIES IN SOFTSHELL CLAMS, MYA ARENARIA, ENVIRONMENTALLY EXPOSED TO HERBICIDES.
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
G. R. Gardner, P. P. Yevich, J. Hurst, P. Thayer, and S. Benyi.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 43-51, 1991. 6 fig, 35 ref. NIH Contract NO1-CP-61063.

Descriptors: *Carcinogens, *Clams, *Ecological effects, *Estuaries, *Herbicides, *Maine, *Sediment contamination, *Water pollution effects, Agriculture, Cancer, Epidemiology, Epizootiology, Forestry, Histology, Land use, Oil spills.

Seminomas and dysgerminomas are epizootic in softshell clams, Mya arenaris, from three Maine estuaries contaminated with herbicides. The first epizootic was discovered in 22% of clams collected at Searsport near Long Cove Brook and three culverts that conveyed heating oil and jet fuel spilled from a tank farm in 1971. Data from subsequent epizootiological studies and a series of long-term experimental exposures of softshell clams to no. 2 fuel oil, JP-4, and JP-5 jet fuel in both the laboratory and the field, did not support an etiology by these petroleum products. Germinomas were observed in 3% of the softshell clams collected from Toque Bluffs near Machiasport and from 35% of softshell clams collected from Dennysville. M. arenaris collected at Dennysville had pericardial mesotheliomas and teratoid siphon anomalies in addition to gonadal neoplasms. Estuaries at Dennysville had been contaminated by herbicides in a 1970 accidental spray overdrift during aerial application of Tordon 101 to adjacent forests. Further investigation determined widespread use of the herbicides Tordon 101, 2,4-D, 2,4,5-T, and other agrochemicals for both forestry and blueberry industry applications at Roque Bluffs and Dennysville. Herbicide applications at Searsport were confirmed for railroad property bordering the Long Cove estuary, and for Long Cove Brook adjacent to the estuary where a highway department reportedly cleans its spray equipment. This pattern of herbicide contamination is the only common denominator identified at all three sites where Mya have been found with gonadal neoplasms. (See also W91-11668) (Author's abstract)
W91-11667

CARCINOGENICITY OF BLACK ROCK HARBOR SEDIMENT TO THE EASTERN OYSTER AND TROPHIC TRANSFER OF BLACK ROCK HARBOR CARCINOGENS FROM THE BLUE MUSSEL TO THE WINTER FLOUNDER.
Environmental Protection Agency, Narragansett, RI. Environmental Research Lab.
G. R. Gardner, P. P. Yevich, J. C. Harshbarger, and A. R. Malcolm.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 53-66, 1991. 10 fig, 4 tab, 47 ref. EPA/National Cancer Institute Interagency Agreement MW-75-930029, and NIH N01-61063.

Descriptors: *Black Rock Harbor, *Dredging wastes, *Flounders, *Mussels, *Oysters, *Pesticides, *Sediment contamination, *Water pollution effects, Carcinogens, Connecticut, Field tests, Food chains, Hydrocarbons, Organic compounds, Polychlorinated biphenyls, Polycyclic aromatic hydrocarbons.

The eastern oyster (Crassostrea virginica) developed neoplastic disorders when experimentally exposed both in the laboratory and field to chemically contaminated sediment from Black Rock Harbor (BRH), Bridgeport, Connecticut. Neoplasia was observed in oysters after 30 and 60 days of continuous exposure in a laboratory flow-through system to a 20 mg/L suspension of BRH sediment plus post-exposure periods of 0, 30 or 60 days. Composite tumor incidence was 13.6% (49 neoplasms in 40, n=295) for both exposures. Tumor occurrence was highest in the renal excretory epithelium. Regression of experimental neoplasia was not observed when the stimulus was discontinued. In field experiments, gill neoplasms developed in oysters deployed in cages for 30 days at BRH and 36 days at a BRH dredge material disposal area in Central Long Island Sound, and kidney and gastrointestinal neoplasms developed in caged oysters deployed 40 days in Quincy Bay, Boston Harbor. Oysters exposed to BHR sediment in the laboratory and in the field accumulated high concentrations of polychlorinated biphenyls (PCB's), polycyclic aromatic hydrocarbons (PAH's) and chlorinated pesticides. The uptake of parent PAH and PCBs from BRH sediment observed in oysters also occurs in blue mussels (Mytilus edulis). Winter flounder fed BRH-contaminated blue mussels contained xenobiotic chemicals found in mussels. The flounder developed renal and pancreatic neoplasms and hepatotoxic neoplastic precursor lesions, demonstrating trophic transfer of sediment-bound carcinogens up the food chain. (See also W91-11667) (Author's abstract)
W91-11668

CARCINOGEN ADDUCTS AS AN INDICATOR FOR THE PUBLIC HEALTH RISKS OF CONSUMING CARCINOGEN-EXPOSED FISH AND SHELLFISH.
British Columbia Cancer Research Center, Vancouver.
B. P. Dunn.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 111-116, 1991. 2 fig, 2 tab, 51 ref. National Science and Engineering Research Council of Canada Grant No. A3403.

Descriptors: *Bioaccumulation, *Bioindicators, *Carcinogens, *Fish, *Metabolism, *Path of pollutants, *Public health, *Shellfish, *Toxicology, *Water pollution effects, Ecotoxicology, Fish physiology, Food chains, Polycyclic aromatic hydrocarbons, Risk assessment.

A large variety of environmental carcinogens are metabolically activated to electrophilic metabolites that can bind to nucleic acids and protein, forming covalent adducts. In an organism with active metabolic systems for a given carcinogen, adducts are much longer lived than the carcinogens that formed them. The detection of DNA-, or protein-carcinogen adducts in aquatic foodstuffs can act as an indicator of prior carcinogen exposure; the presence of DNA adducts suggests a mutagenic/carcinogenic risk to the aquatic organism itself. Fish are characterized by high levels of carcinogen metabolism, low body burdens of carcinogens, the formation of carcinogen-macromolecule adducts, and the occurrence of pollution-related tumors. Shellfish have low levels of carcinogen metabolism, high body burdens of carcinogens and have little or no evidence of carcinogen-macromolecule adducts or tumors. The consumption of carcinogen adducts in

aquatic foodstuffs is unlikely to represent a human health hazard. There are no metabolic pathways by which protein-carcinogen or DNA-carcinogen adducts could reform carcinogens. Incorporation via salvage pathways of preformed nucleoside-carcinogen adducts from foodstuffs into newly synthesized human DNA is theoretically impossible. However, absolute levels of nucleoside-carcinogen levels in aquatic foodstuffs from polluted areas are very low, and the incorporation of preformed adducts into DNA is strongly discriminated against by the fidelity of DNA synthesis. (Author's abstract)
W91-11674

CRITICAL EFFECTIVE METHODS TO DETECT GENOTOXIC CARCINOGENS AND NEOPLASM-PROMOTING AGENTS.
American Health Foundation, Inc., Valhalla, NY.
For primary bibliographic entry see Field 5A.
W91-11675

CARCINOGENESIS STUDIES IN RODENTS FOR EVALUATING RISKS ASSOCIATED WITH CHEMICAL CARCINOGENS IN AQUATIC FOOD ANIMALS.
National Inst. of Environmental Health Sciences, Research Triangle Park, NC.
For primary bibliographic entry see Field 5A.
W91-11676

RISKS OF CONSUMPTION OF CONTAMINATED SEAFOOD: THE QUINCY BAY CASE STUDY.
Metcalf and Eddy, Inc., Wakefield, MA.
C. B. Cooper, M. E. Doyle, and K. Kipp.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 133-140, 1991. 3 fig, 4 tab, 15 ref.

Descriptors: *Cancer, *Food chains, *Organic pollutants, *Path of pollutants, *Public health, *Quincy Bay, *Regulations, *Risk assessment, *Sediment contamination, *Wastewater disposal, *Water pollution effects, Case studies, Chlordane, DDT, Lobster, Fish, Massachusetts, Organic compounds, PCB, Polychlorinated biphenyls, Polycyclic aromatic hydrocarbons, Standards.

A recent EPA-sponsored study of sediment and seafood contamination in Quincy Bay, Massachusetts, revealed elevated levels of several complex organic pollutants frequently of concern in human health assessments. These organic pollutants included chlordane, polycyclic aromatic hydrocarbons, polychlorinated biphenyls and DDT. A seafood consumption risk assessment was conducted using data from samples collected in Quincy Bay, Massachusetts using the methodology developed for EPA's Office of Marine and Estuarine Protection for such assessments. Results showed estimated plausible, upperbound excess cancer risks in the 0.00001 to 0.01 range. These results are comparable to those found in other seafood contamination risk assessments for areas where consumption advisories and fishing restrictions were implemented. Regulatory response included consumption advisories for lobster tomalley (hepatopancreas) and other types of locally caught seafood. Uncertainties inherent in seafood risk assessment included: representativeness of the measured values for contaminants; use of the standard EPA risk assessment assumptions; affected population size and consumption patterns; and transfer pathways of pathogens in seafood. Additional laboratory studies should be conducted to reduce uncertainty about the validity of basic seafood risk assessment assumption such as those in the EPA guidance, and to investigate pathogen transfer. (Author's abstract)
W91-11677

EPIDEMIOLOGIC APPROACHES TO ASSESSING HUMAN CANCER RISK FROM CONSUMING AQUATIC FOOD RESOURCES FROM CHEMICALLY CONTAMINATED WATER.
Boston Univ., MA. School of Public Health.
D. Ozonoff, and M. P. Longnecker.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 141-146, 1991. 79 ref.

Descriptors: *Data acquisition, *Epidemiology, *Public health, *Risk assessment, *Toxicology, *Water pollution effects, Cancer, Data interpretation, Fish consumption, Food chains, Literature review, Statistical analysis, Surveys.

Current knowledge of harmful effects of environmental pollutants comes from three sources: clinical case descriptions, toxicological experiments, and epidemiological studies. Environmental epidemiology is an observations, not an experimental, science. The environmental epidemiologist finds a natural experiment occurring in the laboratory of the real world, observes its outcome, and then arranges the observations in a manner that produces the most information. There are three principal varieties of study design in common use, along with various hybrids of the main types. The most familiar design, because of its similarity to the laboratory experiment, is the cohort or follow-up study. In this method, two groups of individuals differing in exposure are observed for a period of time and then compared with respect to their disease experience. The second principal design is the case-control study. Here a group of individuals with particular disease (the cases) are compared to a group of individuals with particular disease (the controls) to see if their prior exposures differ. For this type of study to be valid the disease process must not influence the information on exposure. In the third type of study design, the cross-sectional study, disease and exposure status are determined at a single and concurrent point in time. This is appropriate when the exposure is some trait or characteristics that can plausibly be held to precede the development of the disease (e.g., blood type). For long latency disease, like cancer, where the development of a solid tumor is usually > 15 to 20 years after exposure to a carcinogen, information must be available over a significantly long period of time. To analyze food intake, when intake is recalled with less than perfect accuracy, four studies were undertaken to examine the reproducibility or validity of questionnaires. It was determined that measurement of fish consumption in the past, by recall, its possible, but the data is, in fact, less than reliable. (Feder-PTT)
W91-11678

LONG-TERM CHANGES IN ZOOPLANKTON ABUNDANCE AND WATER TRANSPARENCY IN LAKE GENEVA.
Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Inst. de Limonologie.
For primary bibliographic entry see Field 2H.
W91-11685

DYNAMICS OF BACTERIOPLANKTON IN OLIGOTROPHIC AND EUTROPHIC AQUATIC ENVIRONMENTS: BOTTOM-UP OR TOP-DOWN CONTROL.
Groupe de Microbiologie des Mileux Aquatiques, Brussels (Belgium).
For primary bibliographic entry see Field 2L.
W91-11686

TROPHIC STRUCTURE AND PRODUCTIVITY OF THE LAGOONAL COMMUNITIES OF TIKEHAU ATOLL (TUAMOTU ARCHIPELAGO, FRENCH POLYNESIA).
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 2L.
W91-11687

SEASONAL COUPLING BETWEEN PHYTO- AND BACTERIOPLANKTON IN A SAND PIT LAKE (CRETEIL LAKE, FRANCE).
Ecole Normale Superieure, Paris (France). Lab. d'Ecologie.
For primary bibliographic entry see Field 2H.
W91-11689

DYNAMICS OF BACTERIOPLANKTON IN A MESOTROPHIC FRENCH RESERVOIR (PAREL OUP).
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W91-11690

TRANSFERS BETWEEN A EUTROPHIC ECOSYSTEM, THE RIVER RHONE, AND AN OLIGOTROPHIC ECOSYSTEM, THE NORTHWESTERN MEDITERRANEAN SEA.
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 2L.
W91-11692

MODIFICATIONS IN HABITAT USE PATTERNS AND TROPHIC INTERRELATIONSHIPS IN THE FISH FAUNA OF AN OLIGOTROPHIC ARTIFICIAL LAKE: SAINTE CROIX (PROVENCE, FRANCE).
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W91-11704

GROWTH RATE OF FOUR FRESHWATER ALGAE IN RELATION TO LIGHT AND TEMPERATURE.
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W91-11706

ALKALINE PHOSPHATASE ACTIVITY FLUCTUATIONS AND ASSOCIATED FACTORS IN A EUTROPHIC LAKE DOMINATED BY OSCILLATORIA RUBESCENS.
Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Inst. de Limonologie.
H. Feuillade, M. Feuillade, and P. Blanc.
Hydrobiologia HYDRB8, Vol. 207, p 233-240, November 22, 1990. 4 fig, 21 ref.

Descriptors: *Algal blooms, *Cyanophyta, *Enzymes, *Eutrophic lakes, *Limnology, *Phosphatases, *Phytoplankton, Chlorophyll a, Correspondence analysis, Inorganic phosphorus, Lake Nantua, Limiting nutrients, Nitrogen, Nitrogen cycle, Phosphorus, Phosphorus cycle, Temporal distribution.

Alkaline phosphatase activity (APA) was investigated monthly for 4 years in the eutrophic Lake Nantua, a lake colonized by a large population of cyanobacteria. Total enzymatic activity, as well as specific activities, (the ratios between APA and biomass expressed as dry weight, chlorophyll a, cell phosphorus) varied strongly but they followed a similar pattern during each year. The data were processed using correspondence analysis. Specific APA was never related to depth but the highest activities were always associated with low particulate phosphorus and nitrogen, low dissolved inorganic phosphorus (DIP) concentrations, low chlorophyll a to filament number ratio and zero nitrate in the waters, indicating phosphorus and nitrogen limiting conditions. Low activities were associated only with high chlorophyll a to filament number ratio. The results suggest that, during summer phosphorus-depletion and as long as the nitrogen/phosphorus ratio is close or above an optimum value, the DIP enzymatically regenerated from the dissolved organic phosphorus (DOP) pool by phosphatases could temporarily contribute to the algal phosphorus supply. (Author's abstract)
W91-11708

EFFECTS OF SELECTIVE FISH PREDATION ON THE HORIZONTAL DISTRIBUTION OF PELAGIC CLADOCERA IN A SOUTHERN FRENCH RESERVOIR.
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W91-11711

SEASONAL VARIATION IN THE INTERACTIONS BETWEEN PISCIVOROUS FISH, PLANKTIVOROUS FISH AND ZOOPLANKTON IN A SHALLOW EUTROPHIC LAKE.
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 2H.
W91-11713

PHOSPHATASES REVISITED: ANALYSIS OF PARTICLE-ASSOCIATED ENZYME ACTIVITIES IN AQUATIC SYSTEMS.
Kinneret Limnological Lab., Tiberias (Israel).
For primary bibliographic entry see Field 2K.
W91-11714

DIRECT MEASUREMENT OF NANOMOLAR NITRATE UPTAKE BY THE MARINE DIATOM PHAEODACTYLUM TRICORNUTUM (BOHLIN): IMPLICATIONS FOR STUDIES OF OLIGOTROPHIC ECOSYSTEMS.
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 2L.
W91-11717

DATABASE OF CHEMICAL TOXICITY TO ENVIRONMENTAL BACTERIA AND ITS USE IN INTERSPECIES COMPARISONS AND CORRELATIONS.
D. J. W. Blum, and R. E. Speece.
Research Journal of the Water Pollution Control Federation RJWFE7, Vol. 63, No. 3, p 198-207, May/June 1991. 1 fig, 5 tab, 20 ref. NSF Grant ECEK-86-17101.

Descriptors: *Bacteria, *Benzenes, *Bioassay, *Chlorinated hydrocarbons, *Interspecific comparisons, *Phenols, *Testing procedures, *Toxicity, *Toxicology, Correlation analysis, Databases, Fathead minnows, Methane bacteria, Microtox, Nitrosomonas.

The toxicity of 50 to 100 chemicals to each of 3 bacterial groups: aerobic heterotrophs, Nitrosomonas, and methanogens was determined. The chemicals tested comprised important environmental pollutants such as chlorinated aliphatic hydrocarbons and halogenated and other substituted benzenes and phenols. Aerobic heterotrophs and methanogens showed similar sensitivities to toxicants, with the exception of an enhanced susceptibility of methanogens to chlorinated aliphatic hydrocarbons and chlorinated alcohols. Based on literature data, Nitrosomonas, Microtox, and the fathead minnow showed similar sensitivities as one another, which were significantly greater (one order of magnitude) than the sensitivities of the aerobic heterotrophs and methanogens. Correlations among the toxicities to different organisms allow predictions of a chemical's toxicity to one organism to be made based on the toxicity of that chemical to a different organism. Excellent correlations (r sq = 0.90 to 0.94) were found between chemical toxicities to the aerobic heterotrophs, methanogens (with chlorinated aliphatic hydrocarbons omitted), and fathead minnows. Good correlations (r sq = 0.70 to 0.82) were found between Microtox and each of the other bacteria and the fathead minnow. The successful interspecies comparisons and correlations indicated by these results illustrate that toxicity testing may be streamlined by developing and using relationships between chemical toxicities to different aquatic organisms. (Author's abstract)
W91-11756

NEW TRENDS IN INFECTIONS ASSOCIATED WITH SWIMMING-POOLS.
Pretoria Univ. (South Africa). Dept. of Medical Virology.
W. O. K. Grabow.
Water SA WASADV, Vol. 17, No. 2, p 173-177, April 1991. 1 tab, 44 ref.

Descriptors: *Disinfection, *Human diseases, *Pathogens, *Public health, *Recreation, *Swimming pools, *Water treatment, Fungi, Infection, Pathogenic bacteria, Protozoa, Viruses.

The transmission of a wide variety of infectious diseases by swimming-pool water has been confirmed by sound evidence based on epidemiological findings and data on the quality of the water concerned. Although the transfer of many pathogens by swimming-pool water has been proven, and many other pathogens are potentially transferable but not yet confirmed, there are certain pathogens for which transfer through swimming-pool water is most unlikely if not impossible. This would include those pathogens which are transmitted by the direct inoculation of blood or blood products, such as the viruses which cause rabies, hemorrhagic fevers, hepatitis type B, and the acquired immuno deficiency syndrome (AIDS). Pathogens associated with swimming-pool transmission include: bacteria, fungi, viruses, protozoa, and unconfirmed potential infections. Routine surveillance of swimming-pool water for safety includes microbial quality, disinfection capacity, disinfection efficiency, water treatment efficiency, general hygiene, and overall quality control. Although chlorine is the most commonly used disinfectant in the swimming-pool industry, a variety of other antimicrobial agents and disinfection processes are being used. These are halogens other than chlorine, ozone, ultraviolet light irradiation, and ions of metals such as silver and copper. Accumulating evidence on diseases transmitted by swimming-pools and related environments, emphasizes the importance of consistent endeavors to maintain the highest possible hygienic conditions at all times. The control of infection risks requires ongoing research on the pathogens concerned; the development of reliable and practical methods for routine quality surveillance; assessment of the efficiency of disinfection processes; and evaluation of the behavior and survival of pathogens in new swimming-pool and related facilities. (White-Reimer-PTT)
W91-11774

REGIONAL CLIMATE CHANGE IMPACTS: I. IMPACTS ON WATER RESOURCES.
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. A. Mimikou, and Y. S. Kouvopoulos.
Hydrological Sciences Journal HSJODN, Vol. 36, No. 3, p 247-258, June 1991. 3 fig, 5 tab, 8 ref.

Descriptors: *Air pollution effects, *Climatology, *Global warming, *Greece, *Hydrologic budget, *Mountain watersheds, *Precipitation, *Water resources, Climatic effects, Melt water, Model studies, Runoff, Snow.

Regional effects of greenhouse warming on water resources, and more specifically on surface runoff, were assessed for a mountainous region of central Greece comprising four drainage basins. A conceptual model and plausible hypothetical scenarios of temperature and precipitation change were used for this assessment. Conclusions drawn from this research are that: (1) mountainous, seasonally snow-covered Mediterranean basins with effective water retentive mechanisms exhibit, under temperature increase, serious reduction of mean annual runoff, even more serious reduction of summer runoff, and minimum annual runoff along with a significant increase in water runoff and maximum annual runoff. In general, reductions are more intense than increases, due to the conducive effect of evapotranspiration. A warmer, humid basin with local characteristics that inhibit water retention exhibits minimal sensitivity of runoff to temperature increase; (2) in general, a magnification factor characterizes the effects of precipitation change on runoff, and can be thought of as a measure of basin sensitivity to precipitation change; (3) the already high seasonality of runoff of the Mediterranean type is intensified in basins sensitive to temperature increase, with apparent consequences on reservoir storage capacity; and (4) snow is distinguished as the most significant and determining factor of basin response to climatic change. This factor, in turn, depends on the orographic characteristics of the basin besides the general climatic ones. (See also W91-11796) (Lantz-PTT)
W91-11795

REGIONAL CLIMATE CHANGE IMPACTS: II. IMPACTS ON WATER MANAGEMENT WORKS.
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. A. Mimikou, P. S. Hadjisavva, Y. S. Kouvopoulos, and H. Afrateos.
Hydrological Sciences Journal HSJODN, Vol. 36, No. 3, p 259-270, June 1991. 7 fig, 1 tab, 5 ref.

Descriptors: *Air pollution effects, *Climatology, *Global warming, *Greece, *Hydrologic budget, *Water resources management, Climatic effects, Energy, Hydroelectric power, Precipitation, Reservoir storage, Reservoirs.

The sensitivity of some critical water management issues, such as reservoir storage and hydroelectric production, to climatic variability and change on a regional basis, is analyzed and presented. By using a set of plausible hypothetical climate scenarios to represent both greenhouse warming and precipitation changes, the sensitivity of the guaranteed annual fresh water and energy supply levels was evaluated under conditions of altered runoff for four connected multi-purpose reservoirs in central Greece. It was shown that reservoirs designed and operated under current climatic conditions are, in general, affected by the climatic changes examined. A dramatic increase in the risk associated with the annual guaranteed quantity of water supply and energy production would occur if greenhouse warming were accompanied by a reduction in annual precipitation. Significant increases of storage volume would then be needed to maintain existing water and energy yields at tolerable risk levels. (See also W91-11795) (Author's abstract)
W91-11796

TRANSFORMATIONS OF NITROGEN IN A PINUS RADIATA FOREST SOIL FLOOD IRRIGATED WITH TREATED DOMESTIC EFFLUENT.
Lincoln Coll., Canterbury (New Zealand). Dept. of Biochemistry and Microbiology.
S. L. Hames, and M. J. Noonan.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 67-79, 5 fig, 38 ref.

Descriptors: *Land disposal, *Nitrification, *Pine trees, *Productivity, *Wastewater irrigation, *Wastewater treatment, Biomass, Domestic wastes, Forest hydrology, Irrigation effects, Irrigation practices, Nitrogen, Nitrogen removal, Wastewater disposal.

Land application has potential for waste treatment since nutrients and water may be taken up by the irrigated vegetation. However, if ammonium ions and organic nitrogen are the main forms of nitrogen in effluents, and if the application leaves excess ammonium-N in the soil; where conditions are suitable for nitrifying bacteria, ammonium-N will be converted to leachable nitrate-N. Pine (Pinus radiata) forests may have advantages because numbers of autotrophic nitrifying bacteria are generally low and little nitrate is leached. The ammonium ions could be adsorbed and retained by the soil and would not leach even if the trees were not taking up nitrogen during part of the year. Experiments showed that adsorbed ammonium ions were nitrified and numbers of autotrophic nitrifying bacteria increased with wastewater applications but declined soon after. However, the total amount of nitrogen which is removed during logging may make this crop less useful than many others. (See also W91-11805) (Author's abstract)
W91-11812

MICROBIAL ECOLOGY OF THIOBACILLUS FERROOXIDANS.
Alaska Univ., Fairbanks. Water Research Center.
E. J. Brown, B. R. Rasley, D. P. Dixson, S. Hong, and H. V. Luong.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-168989. Price codes: A03 in paper copy, A01 in microfiche. Institute of Northern Engineering, Fairbanks, Report IWR-113, March 1990. 24p, 2 fig, 1 tab, 34 ref. USGS Contract No. 14-08-0001-G1313.

Descriptors: *Bacteria, *Microorganisms, *Thiobacillus, Acid mine drainage, Arsenic removal, Bioleaching, Flotation, Heavy metals, Iron bacteria, Leaching, Microbiological studies, Soil gases.

Thiobacillus ferrooxidans is an extremeophilic microorganism that is normally associated with acid mine drainage. It is an obligate autotroph that grows readily at a pH of 2 with ferrous iron as the sole energy source. Yet, this organism appears to

be quite ubiquitous and has been isolated from a variety of aqueous and terrestrial environments that show no indication of acidity on a macro scale. This study investigated the steady-state growth, microbial ecology and biohydrometallurgical potential of T. ferrooxidans. The report is divided into two sections which summarize more detailed works which have been published in one thesis, one report and one journal article. A third section summarizes the most recent results which show that T. ferrooxidans can grow autotrophically with molecular hydrogen as a sole energy source. These results indicate that the physiological ecology of the thiobacilli in general and T. ferrooxidans in particular is much more complex than generally believed. The bioenergetic significance of these findings is yet to be determined, however, they must now be considered when future studies consider the role of these organisms in the biogeochemistry of soil gases, geothermal vents, metal corrosion and leaching of sulfide minerals. (USGS)
W91-11908

INDIVIDUAL PARTICLE ANALYSIS OF SUSPENDED MATERIALS IN ONONDAGA LAKE, NEW YORK.
State Univ. of New York, Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 2H.
W91-11966

PROPANIL: TOXICOLOGICAL CHARACTERISTICS, METABOLISM, AND BIODEGRADATION POTENTIAL IN SOIL.
National Center for Toxicological Research, Jefferson, AR.
For primary bibliographic entry see Field 5B.
W91-11994

TRANSPORT AND PREDICTION OF SULFATE IN AGRICULTURAL RUNOFF.
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W91-12001

REDUCTION OF DISSOLVED OXYGEN CONCENTRATION IN WISCONSIN STREAMS DURING SUMMER RUNOFF.
Geological Survey, Madison, WI.
For primary bibliographic entry see Field 5B.
W91-12005

SPATIAL VARIATIONS OF SAPWOOD CHEMISTRY WITH SOIL ACIDITY IN APPALACHIAN FORESTS.
Pennsylvania State Univ., University Park. School of Forest Resources.
D. R. DeWalle, B. R. Swistock, R. G. Sayre, and W. E. Sharpe.
Journal of Environmental Quality JEVQAA, Vol. 20, No. 2, p 486-491, 1991. 6 fig, 2 tab, 22 ref.

Descriptors: *Acidic soils, *Acidity, *Appalachian forests, *Dendrochronology, *Paleotoxicology, *Pollutant identification, *Soil chemistry, *Trees, *Water pollution effects, Calcium, Hydrogen ion concentration, Leachates, Manganese, Plant physiology, Strontium, Tree rings.

Studies were conducted at five Appalachian sites to determine if chemical element concentrations in sapwood tree rings from six tree species varied with soil and soil leachate acidity. The most recent 5-yr-growth increment was extracted from 10 tree boles of each species at each site and analyzed for chemical content using plasma emission spectroscopy. Sapwood tree rings generally showed higher concentrations of Mn and lower concentrations of Sr at sites with lower soil pH. Differences in tree-ring concentrations for Ca and Mn among sites were also found in soil water samples at these sites. Significant differences in soil leachate Al between sites were not duplicated in tree rings. Sapwood tree-ring chemistry in red oak (Quercus rubra L.), black cherry (Prunus serotina Ehrh.), eastern white pine (Pinus strobus L.) and eastern hemlock (Tsuga canadensis (L.) Carr.) was generally responsive to differences in soil chemistry between sites. Chestnut oak (Q. prinus L.) and pignut hickory (Carya glabra (Mill.) Sweet) were the least responsive species tested. Overall, results show that several common tree species and selected elements are potentially useful for studying historic soil acidification trends at these study sites. (Author's abstract)
W91-12008

EFFECT OF SUBLETHAL CONCENTRATIONS OF FOUR CHEMICALS ON SUSCEPTIBILITY OF JUVENILE RAINBOW TROUT (ONCORHYNCHUS MYKISS) TO SAPROLEGNIOSIS.
Instituto Nacional de Investigaciones Agrarias, Madrid (Spain). Centro de Investigacion y Tecnologia.
M. Carballo, and M. J. Munoz.
Applied and Environmental Microbiology AEMIDF, Vol. 57, No. 6, p 1813-1816, June 1991. 2 tab, 37 ref. I.N.I.A. Research Project No. 8171.

Descriptors: *Ammonia, *Copper, *Cyanide, *Fish diseases, *Nitrites, *Sublethal effects, *Trout, *Water pollution effects, Aquatic fungi, Fungi, Saprolegniosis, Spores, Toxicity.

Mycotic infections with members of the family Saprolegniaceae are widely reported in freshwater fish. Although salmonid fish come into contact with many fungal spores, only Saprolegnia parasitica and other Saprolegnia spp., characterized by groups of long hookered hairs on the secondary zoospore cyst, have been isolated from fungal lesions on live salmonid fish. Sublethal concentrations of un-ionized ammonia (0.05 mg/L) and nitrite (0.12 mg/L) increased trout susceptibility after 10 days of exposure to the toxin, this increase being higher for ammonia (75% and 20% morbidity) than for nitrite (20% and 0% morbidity, respectively) with inoculum doses of 1,400,000 and 950,000 zoospores per liter. Sublethal concentrations of copper (0.05 mg/L) or cyanide (0.05 mg/L) did not show enhancement of infection by S. parasitica, even though the toxin exposure was for 21 days and the inoculum doses were higher than those for the experiments with the nitrogen compounds (4,000,000 and 3,200,000 zoospores per liter). However, infections began to appear in control animals. (Lantz-PTT)
W91-12015

SEASONAL VARIABILITY IN THE SENSITIVITY OF FRESHWATER PHYTOPLANKTON COMMUNITIES TO A CHRONIC COPPER STRESS.
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winnter, and H. A. Owen.
Aquatic Toxicology AQTODG, Vol. 19, No. 2, p 73-88, April 1991. 7 fig, 3 tab, 13 ref.

Descriptors: *Copper, *Phytoplankton, *Seasonal variation, *Toxicity, *Toxicology, *Water pollution effects, Algae, Algal growth, Biological studies, Brandenburg Pond, Ecotoxicology, Heavy metals, Limnology, Ohio, Stress.

Although a number of laboratory experiments have evaluated the sensitivity of selected algae to a Cu stress, very few studies have evaluated the sensitivity of natural assemblages of phytoplankton to Cu. To better evaluate Cu stress on phytoplankton communities, experiments were conducted for 5-wk periods during March 30-May 5, 1987, June 8-July 13, 1988, October 7-November 14, 1988 and April 3-May 8, 1989 in Brandenburg Pond, southwestern Ohio. Enclosures were 100-L polyethylene bags filled with pond water using a diaphragm pump. Total Cu concentrations were monitored in each enclosure at 2-3 day intervals at which times Cu was added to maintain the desired concentrations. Phytoplankton was sampled on day one, prior to the first Cu addition, and weekly thereafter for a 5-wk period. Based on total algal densities, number of taxa affected and community richness, the community was more sensitive to Cu in the spring than in summer or fall. Except for the Cryptophyta, which were sensitive to Cu at all seasons, other algal divisions exhibited seasonal variability in their sensitivity to Cu. The greater spring sensitivity to Cu agrees with previously published data on seasonal sensitivity of zooplankton to Cu. (Lantz-PTT)
W91-12016

TOXICITY OF COPPER TO THE GREEN ALGA, CHLAMYDOMONAS REINHARDTII (CHLOROPHYCEAE), AS AFFECTED BY HUMIC SUBSTANCES OF TERRESTRIAL AND FRESHWATER ORIGIN.
Miami Univ., Oxford, OH. Dept. of Zoology.
J. E. Garvey, H. A. Owen, and R. W. Winner.
Aquatic Toxicology AQTODG, Vol. 19, No. 2, p 89-96, April 1991. 4 fig, 1 tab, 12 ref.

Descriptors: *Algae, *Copper, *Humic acids, *Toxicity, *Toxicology, *Water pollution effects, Algal growth, Algal physiology, Fulvic acids, Heavy metals.

Population growth, loss of flagella and encystment were used as indices of copper toxicity to Chlamydomonas reinhardtii. Copper concentrations up to 64 microgm/L had no effect on population growth in any of the treatments. Deflagellation occurred at Cu concentrations ranging from 6.7 to 25.4 microgm/L, with terrestrial humic acid (HA) having the greatest effect on toxicity and aqueous fulvic acid (FA) having no effect on toxicity. The effect of aqueous HA was intermediate. Encystment was a less sensitive index of Cu toxicity than was deflagellation, but it may offer protection against extinction when algae are exposed to pulses of higher Cu concentrations. Based on these results, terrestrially derived humic acids appear to be an inappropriate model to be used in predicting the effects of freshwater humic substances on the toxicity of metals. (Author's abstract)
W91-12017

CADMIUM ACCUMULATION AND DETOXIFICATION IN A CD-RESISTANT POPULATION OF THE OLIGOCHAETE LIMNODRILUS HOFFMEISTERI.
State Univ. of New York at Stony Brook. Dept. of Ecology and Evolution.
P. L. Klerks, and P. R. Bartholomew.
Aquatic Toxicology AQTODG, Vol. 19, No. 2, p 97-112, April 1991. 4 fig, 1 tab, 49 ref.

Descriptors: *Cadmium, *Ecotoxicology, *Oligochaetes, *Physiological ecology, *Toxicology, *Water pollution effects, Annelids, Biochemistry, Cadmium radioisotopes, Cobalt, Foundry Cove, Genetics, Heavy metals, Helminths, New York, Nickel, Proteins.

In previous studies, it was reported that the oligochaete Limnodrilus hoffmeisteri from metal polluted Foundry Cove, has evolved resistance to a combination of cadmium, nickel and cobalt. This review paper addresses the possible physiological mechanisms by which this resistance is achieved. Exposing animals from both the control population and the resistant population to Foundry Cove sediment or to 109-Cd in water, shows that the resistance is not achieved by a reduced Cd accumulation. High performance liquid chromatography gel-permeation of the cytosol obtained after the exposure to 109-Cd in water reveals that the resistant worms have significantly higher levels of a Cd-binding, metallothionein-like protein than control worms. This elevated protein level is shown to be genetically determined and is proposed to contribute to the resistance of L. hoffmeisteri from Foundry Cove. In addition, electron microprobe analyses of Foundry Cove worms exposed to metal-rich sediment demonstrated the presence of Cd in granules. High levels of Cd were found in S-rich granules, possibly in the form of Cd sulfide. These granules occurred both individually and as large granular aggregates. (Author's abstract)
W91-12018

ACUTE TOXICITY OF PULSE-DOSED THIOCYANATE (AS KSCN AND NASCN) TO RAINBOW TROUT (ONCORHYNCHUS MYKISS) EGGS BEFORE AND AFTER WATER HARDENING.

Waterloo Univ. (Ontario). Dept. of Biology.
S. D. Kevan, and D. G. Dixon.
Aquatic Toxicology AQTODG, Vol. 19, No. 2, p 113-122, April 1991. 2 fig, 3 tab, 20 ref. Ontario Ministry of the Environment Grant 320 PL, and the Natural Sciences and Engineering Research Council of Canada Operating Grant A8155.

Descriptors: *Fish eggs, *Thiocyanate, *Toxicity, *Toxicology, *Trout, *Water pollution effects, Cyanide, Ecotoxicology, Fertilization, Mortality, Sublethal effects.

Thiocyanate (SCN(-)) is often produced when cyanides are used in industry. The acute toxicity of waterborne SCN(-) to fully-developed rainbow trout has previously been determined during continuous exposure. Threshold LC50 values range from 40 to 265 mg SCN(-)/L depending on the temperature, pH and hardness of the test water. There is, however, no information on the sensitivity of the eggs or larvae of fish to SCN(-) under any exposure regime, including intermittent pulse exposure. To determine the toxicity of a single pulse of SCN(-) to rainbow trout eggs at two stages of development (directly after fertilization before water hardening, and after water hardening when the egg has formed the chorion), rainbow trout eggs were exposed to a 3-hr pulse exposure of SCN(-) as either KSCN or NaSCN. Observations on fertilization success, mortality, incidence of deformities and embryonic heartrate were recorded for 5 wk at 13.5 C. Pulse exposure adversely affected the survival and development of the eggs, both before and after water hardening. Significant egg mortality occurred at SCH(-) concentrations >/= 2,700 and 1,290 mg/L in the before and after treatments, respectively. Alevins that hatched from treated eggs exhibited abnormalities of the tail and spine after exposure to KSCN and NaSCN. Deformities occurred at significantly higher frequencies, relative to controls, at SCN(-) concentrations >/= 85 and 2,700 mg/L before and after water hardening, respectively. Embryonic heart-rates were not significantly affected by NaSCN. (Lantz-PTT)
W91-12019

CHANGES IN THE PHYSIOLOGICAL PERFORMANCE AND ENERGY METABOLISM OF AN ESTUARINE MYSIDE (MYSIDOPSIS BAHIA) EXPOSED IN THE LABORATORY THROUGH A COMPLETE LIFE CYCLE TO THE DEFOLIANT DEF.

Environmental Research Lab., Gulf Breeze, FL.
C. L. McKenney, T. L. Hamaker, and E. Matthews.
Aquatic Toxicology AQTODG, Vol. 19, No. 2, p 123-135, April 1991. 3 fig, 4 tab, 32 ref.

Descriptors: *DEF, *Defoliants, *Estuaries, *Opossum-shrimp, *Toxicology, *Water pollution effects, Ammonia, Growth rates, Nitrogen, Oxygen, Physiological ecology, Physiology, Reproduction, Shrimp, Sublethal effects, Toxicity.

Measures of physiological performance and energy metabolism were made on an estuarine mysid (Mysidopsis bahia) exposed throughout a life cycle to the defoliant DEF. Continuous exposure to DEF concentrations >/= 0.236 microgm/L reduced survival through release of the first brood. Young production by individual females was completely arrested in DEF concentrations >/= 0.606 microgm/L. Life-cycle exposure to concentrations >/= 0.085 microgm DEF/L reduced young production by the population. An interaction between mysid age and DEF exposure concentration, modified growth rates and energy metabolism. Growth of early juveniles was not altered by DEF exposure. However, concentrations >/= 0.140 microgm/L and >/= 0.085 microgm/L retarded growth rates in older juveniles and young adults, respectively. Exposure to these same DEF concentrations stimulated respiration rates of most juvenile stages and young adults. Following 5 days exposure to DEF concentrations >/= 0.085 microgm/L, mysids excreted less ammonia. O:N ratios of unexposed mysids became lower as juveniles matured, while DEF exposure resulted in higher O:N ratios. Higher O:N ratios during maturation of DEF-exposed mysids suggests greater reliance on energy-rich lipid substrates to support elevated metabolic demands, leaving reduced lipids for reproductive preparations. (Author's abstract)
W91-12020

PROOXIDANT AND ANTIOXIDANT MECHANISMS IN AQUATIC ORGANISMS.

Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
G. W. Winston, and R. T. Di Giulio.
Aquatic Toxicology AQTODG, Vol. 19, No. 2, p 137-161, April 1991. 1 fig, 123 ref.

Descriptors: *Aquatic life, *Biochemistry, *Limnology, *Toxicology, *Water pollution effects, Antioxidants, Literature review, Oxygen, Prooxidants, Toxicity.

A consequence of all aerobic life is the production of potentially harmful, partially reduced species of molecular oxygen (oxyradicals) that occurs as a result of normal oxygen metabolism. In view of this potential for harm, aerobic organisms have evolved a complex armamentarium of defenses to protect them against the possible ravages of oxyradical production. A recent growing body of evidence indicates a marked penchant for augmented oxyradical production in aquatic organisms resulting largely from anthropogenic pollutant outfalls. Two consequences of environmental contamination might be envisaged; certain compounds which cause increased oxyradical flux could exacerbate the deleterious effects of oxyradicals or the increased fluxes could affect induction of antioxidant enzymes thereby overcoming the stresses imposed by the contaminating compound(s). This review describes the various adaptational mechanisms and responses, including the toxicological consequences, associated with oxyradical production. The broad phylogenetic spectrum of examples discussed illustrate that while there are numerous differences among the phyla with respect to both pro-oxidant and anti-oxidant mechanisms to establish a vigorous basis of inquiry, enough striking similarities also exist to suggest the use of aquatic organisms as alternative models to mammals in various areas of oxyradical research, e.g. aging and cancer. In addition, the potential use of anti-oxidant responses, e.g. induction of specific anti-oxidant enzymes as biomarkers of environmental contamination is reviewed. (Author's abstract)
W91-12021

THREATS TO BIOLOGICAL DIVERSITY IN MARINE AND ESTUARINE ECOSYSTEMS OF FLORIDA.

Florida Inst. of Tech., Melbourne. Dept. of Biological Sciences.
D. E. De Freese.
Coastal Management CZMJBF, Vol. 19, No. 1, 73-101 p, January/March 1991. 5 fig, 4 tab, 70 ref.

Descriptors: *Environmental policy, *Environmental protection, *Estuaries, *Florida, *Marine environment, *Species diversity, Coastal zone management, Florida Keys, Indian River Lagoon, Legislation, Wetlands.

The Indian River Lagoon of east central Florida and the marine ecosystem of the Florida Keys are important natural ecosystems with ecological, economic, esthetic, and recreational values. Both ecosystems have high biological diversity and are threatened by a variety of anthropogenic impacts. Although all coastal marine and estuarine ecosystems are influenced by an interplay of oceanic and terrestrial influences, structural and functional characteristics and anthropogenic impacts are often site-specific. This suggests that ecosystem management and research must focus on a holistic ecosystem approach that establishes ecosystem boundaries, considers the dynamic nature of ecosystem processes, and prioritizes issues and objectives. Although Florida has enacted a framework of coastal zone management legislation, no specific legislation has addressed the issue of biological diversity conservation in marine and estuarine ecosystems. Implementation of a comprehensive coastal zone management plan is confounded by a fragmented infrastructure of governmental agencies, lack of coordination, and inadequate funding for implementation, research, education, and enforcement. Florida's extended coastline, diversified ecosystems, and extensive biological diversity challenges state, regional, and local agencies to develop comprehensive research, management, and education initiatives that are adequately funded and sufficiently focused to ensure long-term ecosystem and biological diversity protection. (Author's abstract)
W91-12026

ACIDIFICATION-RELATED CHANGES IN THE BIOGEOCHEMISTRY AND ECOTOXICOLOGY OF MERCURY, CADMIUM, LEAD AND ALUMINUM: OVERVIEW.

Canadian Wildlife Service, Ottawa (Ontario).
A. M. Scheuhammer.
Environmental Pollution ENPOEK, Vol. 71, No. 2/4, p 87-90, 1991. 1 fig, 7 ref.

Descriptors: *Acid rain, *Acidification, *Aluminum, *Ecotoxicology, *Mercury, *Path of pollutants, *Water pollution effects, *Water pollution sources, Bioaccumulation, Biogeochemistry, Cadmium, Ecosystems, Heavy metals, Hydrogen ion concentration, Lead.

During the past decade, the acidification of aquatic ecosystems has received much scientific and popular attention. A major chemical effect of anthropogenic SOx/NOx deposition is the acidification of a poorly buffered environment, a process that in turn influences the solubility, speciation, environmental mobility, food-chain transfer and toxicity of numerous metals. From a toxicological perspective, the metals of greatest concern, particularly for higher organisms, are Hg, Cd, Pb and Al. Long range transport and deposition of SOx and NOx can disrupt the normal environmental chemistry of both aquatic and terrestrial systems. Chief among these changes is a decline in ambient pH, which in turn influences the environmental chemistry of metals. Effects are generally metal-specific, and modulated by various conditions. Thus, acidification causes increased environmental mobility of Al and Cd and an increased concentration of these metals in surface waters, whereas acidification has a lesser effect on the mobility of Pb and inorganic Hg due to the high binding affinities of these metals for humic substances in soils and sediments. Fish, aquatic plants and invertebrates, and many amphibian species are directly exposed to increased concentrations of H(+), as well as Al(3+) and other metal cations, as a result of the acidification of their habitats. Such changes may lead to the extinction of acid-, or metal-sensitive taxa, and to metal accumulation by remaining, acid-tolerant species. Although the species diversity of aquatic macrophytes is not drastically altered by declining pH down to about pH 5, some aquatic plants, especially submergents, can accumulate very high concentrations of Al and/or Pb as a result of acidification. (Lantz-PTT)
W91-12027

EFFECTS OF ACIDIFICATION ON THE GEOCHEMISTRY OF AL, CD, PB AND HG IN FRESHWATER ENVIRONMENTS: A LITERATURE REVIEW.

INRS-Eau, Sainte-Foy (Quebec).
W. O. Nelson, and P. G. C. Campbell.
Environmental Pollution ENPOEK, Vol. 71, No. 2/4, p 91-130, 1991. 7 fig, 2 tab, 134 ref.

Descriptors: *Acid rain effects, *Acidification, *Aluminum, *Cadmium, *Geochemistry, *Lead, *Literature review, *Mercury, *Water pollution effects, Acid rain, Environmental effects, Heavy metals.

Acidification of freshwater environments (terrestrial, surface water, and freshwater sediment) can significantly affect the geochemistry of Al, Cd, Pb and Hg; for example, metal mobility within soils (Al, Cd), and relative distribution of dissolved metal species (Al, Cd, Pb, Hg), and the sedimentation rate of metals in standing water bodies (Cd, Pb) can be altered by acidification. In this critical review of the literature over the last decade concerned with the interaction of acidification with

these four metals, an assessment of the current state of knowledge in this field is provided, with an emphasis on those areas where significant progress has been made since the possible implications of environmental acidification on metal geochemistry became widely appreciated in the late 1970. Those areas which are most in need of further research are indicated. (Author's abstract)
W91-12028

MERCURY METHYLATION IN AQUATIC SYSTEMS AFFECTED BY ACID DEPOSITION.
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
For primary bibliographic entry see Field 5B.
W91-12029

ACIDIFICATION, METALS AND MACROPHYTES.
Queen's Univ., Kingston (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W91-12030

EFFECT OF ACIDIFICATION ON THE ACCUMULATION AND TOXICITY OF METALS TO FRESHWATER INVERTEBRATES.
B.A.R. Environmental, Toronto (Ontario).
C. D. Wren, and G. L. Stephenson.
Environmental Pollution ENPOEK, Vol. 71, No. 2/4, p 205-241, 1991. 8 tab, 161 ref.

Descriptors: *Acid rain, *Acid rain effects, *Acidification, *Aquatic animals, *Bioaccumulation, *Heavy metals, *Literature review, *Water pollution effects, Aluminum, Cadmium, Hydrogen ion concentration, Lead, Mercury, Metals, Toxicity.

This paper reviews the literature to determine if lowered water pH: (1) affects metal bioaccumulation in freshwater invertebrates; (2) enhances the toxicity of a given metal; and (3) increases waterborne metal concentrations to levels toxic to invertebrates. The elements considered are mercury, lead, cadmium and aluminum. The available evidence suggests that of these elements only Hg is biomagnified in aquatic food chains. The bioaccumulation of all these elements is influenced by water pH, but data concerning invertebrates is meagre for Hg and Pb. The effect of pH on Hg and Pb toxicity to invertebrates is unclear and may be largely species specific. Cadmium toxicity is reduced by lower pH, while Al toxicity to invertebrates is markedly higher due to changes in Al speciation at low pH. (Author's abstract)
W91-12031

METAL BIOAVAILABILITY AND TOXICITY TO FISH IN LOW-ALKALINITY LAKES: A CRITICAL REVIEW.
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
D. J. Spry, and J. G. Wiener.
Environmental Pollution ENPOEK, Vol. 71, No. 2/4, p 243-304, 1991. 4 fig, 5 tab, 310 ref.

Descriptors: *Acid rain effects, *Alkalinity, *Bioavailability, *Fish, *Heavy metals, *Literature review, *Toxicity, *Water pollution effects, Acid rain, Bioaccumulation, Cadmium, Gills, Hydrogen ion concentration, Lead, Mercury, Path of pollutants, Tissue analysis.

Fish in low-alkalinity lakes having pH of 6.0-6.5 or less often have higher body or tissue burdens of mercury, cadmium, and lead than do fish in nearby lakes with a higher pH. The greater bioaccumulation of these metals in such waters seems to result partly from the greater aqueous abundances of biologically available forms ($CH_3Hg(+)$, $Cd(2+)$, ad $Pb(2+)$) at low pH. In addition, the low concentrations of aqueous calcium in low-alkalinity lakes increase the permeability of biological membranes to these metals, which in fish may cause greater uptake from both water and food. Fish exposed to aqueous inorganic Al in the laboratory and field accumulate the metal in and on the epithelial cells of the gills; however, there is little accumulation of Al in the blood or internal organs. In low-pH water, both sublethal and lethal toxicity of Al has been clearly demonstrated in both laboratory and field studies at environmental concentrations. In contrast, recently measured aqueous concentrations of total Hg, methylmercury, Cd, and Pb in low-alkalinity lakes are much lower than the aqueous concentrations known to cause acute or chronic toxicity in fish, although the vast majority of toxicological research has involved waters with much higher ionic strength than that in low-alkalinity lakes. Additional work with fish is needed to better assess: (1) the toxicity of aqueous metals in low-alkalinity waters, and (2) the toxicological significance of dietary methylmercury and cadmium. (Author's abstract)
W91-12032

EFFECTS OF ALUMINUM AND OTHER METALS ON AMPHIBIANS.
Miami Univ., Oxford, OH. Dept. of Zoology.
J. Freda.
Environmental Pollution ENPOEK, Vol. 71, No. 2/4, p 305-328, 1991. 1 fig, 3 tab, 88 ref.

Descriptors: *Acid rain, *Acid rain effects, *Acidification, *Aluminum, *Amphibians, *Literature review, *Water pollution effects, Copper, Field tests, Growth stages, Hardness, Heavy metals, Hydrogen ion concentration, Iron, Lead, Organic carbon, Toxicity, Zinc.

This review discusses the effects of aluminum and other metals associated with acidification on amphibians. The majority of research has centered around aluminum although some information is available regarding copper, cadmium, iron, zinc and lead. The major habitat types in which amphibians live and breed are listed, and the mechanisms by which these habitats may become acidified and contaminated with metals are discussed. Three lines of investigation into acid and metal toxicity are reviewed in detail: (1) field surveys of water chemistry; (2) laboratory toxicity tests; and (3) field studies which include in situ toxicity tests, and surveys of amphibian distribution and survival relative to water chemistry. As a result of recent information from each of these three lines of research, it appears that aluminum toxicity is an extremely complex phenomenon which is influenced by the hardness, pH, dissolved organic carbon of the water, and the developmental stage and species of amphibian. (Author's abstract)
W91-12033

EFFECTS OF ACIDIFICATION ON THE AVAILABILITY OF TOXIC METALS AND CALCIUM TO WILD BIRDS AND MAMMALS.
Canadian Wildlife Service, Ottawa (Ontario).
A. M. Scheuhammer.
Environmental Pollution ENPOEK, Vol. 71, No. 2/4, p 329-375, 1991. 7 fig, 3 tab, 114 ref.

Descriptors: *Acid rain, *Acid rain effects, *Acidification, *Bioavailability, *Calcium, *Heavy metals, *Literature review, *Toxicity, *Water pollution effects, Aluminum, Bioaccumulation, Birds, Cadmium, Ecological effects, Food chains, Hydrogen ion concentration, Lead, Magnesium, Mammals, Mercury, Phosphorus, Selenium, Wildlife.

The effects of acidification on wildlife inhabiting aquatic or semi-aquatic environments are reviewed, with particular reference to the possibility for increased dietary exposure to Hg, Cd, Pb and/or Al, and decreased availability of essential dietary minerals such as Ca. It is concluded that: (1) piscivores risk increased exposure to dietary methyl-Hg in acidified habitats, and Hg concentrations in prey may reach levels known to cause reproductive impairment in birds and mammals; (2) piscivores do not risk increased exposure to dietary Cd, Pb or Al because these metals are either not increased in fish due to acidification, or increases are trivial from a toxicological perspective; (3) insectivores and omnivores may, under certain conditions, experience increased exposure to toxic metals in some acidified environments. Exposure levels are likely to be sufficiently low, however, that significant risks to health or reproduction are unlikely. More importantly, these wildlife species may experience a drastic decrease in the availability of dietary Ca due to the pH-related extinction of high-Ca aquatic invertebrate taxa (mollusks, crustaceans). Decreased availability of dietary Ca is known to adversely affect egg laying and eggshell integrity in birds, and the growth of hatchling birds and neonatal mammals. Acidification-related changes in the dietary availability of other essential elements, such as Mg, Se and P, have not been established and require further investigation; (4) herbivores may risk increased exposure to Al and Pb, and perhaps Cd, in acidified environments because certain macrophytes can accumulate high concentrations of these metals under acidic conditions. The relative importance of pH determining the metal concentrations of major browse species, and the toxicological consequences for herbivorous wildlife, is not well established and requires further study. A decreased availability of dietary Ca is also likely for herbivores inhabiting acidified environments. (Author's abstract)
W91-12034

VERTICAL MIGRATION OF A FLAGELLATE-DOMINATED BLOOM IN A SHALLOW SOUTH AFRICAN ESTUARY.
Port Elizabeth Univ. (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 2L.
W91-12041

EMBRYONIC AND LARVAL DEVELOPMENT OF BROWN TROUT, SALMO TRUTTA L.: EXPOSURE TO TRACE METAL MIXTURES IN SOFT WATER.
Nottingham Univ. (England). Dept. of Zoology.
M. D. J. Sayer, J. P. Reader, and R. Morris.
Journal of Fish Biology JFIBA9, Vol. 38, No. 5, p 773-787, May 1991. 4 fig, 2 tab, 16 ref. Natural Environment Research Council Grant GR3/6176.

Descriptors: *Fish eggs, *Fish larvae, *Toxicology, *Trace metals, *Trout, *Water pollution effects, Aluminum, Cadmium, Copper, Iron, Lead, Magnesium, Manganese, Minerals, Nickel, Potassium, Sodium, Water softening, Zinc.

Freshly fertilized ova of brown trout, Salmo trutta L., were exposed to all possible mixtures of Al (6000 nanomoles/L), Cu (80 nanomoles/L), Pb (50 nanomoles/L) and Zn (300 nanomoles/L). In a separate experiment, newly hatched brown trout yolk-sac fry were exposed to Mn (1500 nanomoles/L), Fe (2500 nanomoles/L), Ni (200 nanomoles/L) or Cd (4 nanomoles/L), separately, and in mixtures with either Al or Cu. Both experiments were conducted in flowing, artificial softwater media nominally at pH 5.6(Ca) 20 micromoles/L and 10 C. Mortalities were high in fry subjected to treatments which contained both Al and Cu (31-72%), and to the Cu+Fe treatment (78%) compared with those from the other trace metal mixtures (0-22%). In all the treatments tested, fry exposed to trace metal mixtures containing Al and/or Cu had reduced whole body Ca, Na and K content, and seriously impaired skeletal calcification. Whole body Mg content was variable. In trace metal mixtures which contained Cu but not Al, the effects on fry survival and whole body mineral content were in general more deleterious than the corresponding mixtures but with Al present rather than Cu. The presence of Pb and/or Zn in mixtures with Al and/or Cu had a slight ameliorative effect in terms both of fry survival and whole body mineral content. (Author's abstract)
W91-12062

INCREASED ABUNDANCE AND GROWTH OF THE SUSPENSION-FEEDING BIVALVE CORBULA GIBBA IN A SHALLOW PART OF THE EUTROPHIC LIMFJORD, DENMARK.
National Environmental Research Inst., Charlottenlund (Denmark).
For primary bibliographic entry see Field 5A.
W91-12069

PHYSICAL AND CHEMICAL CHARACTERS, PHYTOPLANKTON AND PRIMARY PRO-

DUCTION OF EZEQUIEL RAMOS MEXIA RESERVOIR (ARGENTINA).
Universidad Nacional de La Plata (Argentina). Inst. de Limnologia.
For primary bibliographic entry see Field 2H.
W91-12092

PLANKTONIC BACTERIAL BIOMASS AND SEASONAL PATTERN OF THE HETEROTROPHIC UPTAKE AND RESPIRATION OF GLUCOSE AND AMINO ACIDS IN THE SHALLOW SANDPIT LAKE OF CRETEIL (PARIS SUBURB, FRANCE).
Ecole Normale Superieure, Paris (France). Lab. d'Ecologie.
For primary bibliographic entry see Field 2H.
W91-12095

CASE OF UNUSUALLY HIGH OXYGEN DEMAND IN A EUTROPHIC LAKE.
Washington Univ., Seattle. Dept. of Civil Engineering.
H. S. Sehgal, and E. B. Welch.
Hydrobiologia HYDRB8, Vol. 209, No. 3, p 235-243, February 15, 1991. 5 fig, 5 tab, 28 ref.

Descriptors: *Biological oxygen demand, *Eutrophic lakes, *Washington, *Water pollution effects, Aeration, Hypolimnion, North Lagoon, Nutrients, Scriber Lake, Storm runoff, Thermal stratification.

An unusually high hypolimnetic water column BOD (WCBOD), roughly 40 times higher than the sediment oxygen demand (SOD), was observed in a small eutrophic lake and adjoining lagoon (Scriber Lake and North Lagoon, in a park in Lynnwood, Washington). The mean 5-day WCBOD during thermal stratification in the lake was 29 and 49 g/sq m at 10 and 20 C, respectively, whereas in the lagoon it was 47 and 87 g/sq m, respectively. The soluble fraction comprised about two-thirds of the WCBOD. WCBOD in the lake was much less during the unstratified period (5-day = 5 g/sq m). The SOD rates at two depths in both the lake (0.31 and 0.2 g/sq m/day) and lagoon (0.41 and 0.28 g/sq m/day) were not unusually high. The ultimate whole BOD (UWCBOD + USOD) was approximately 96 g/sq m in the lake and 136 g/sq m in the lagoon; UWCBOD formed more than 90% of the ultimate whole BOD in both water bodies). A possible cause of these abnormally high WCBODs, besides the normal autochthonous production, is an allochthonous source from loosely aggregated and flocculent mats of Sphagnum, which surrounds the lake-lagoon system. Storm water per se clearly was insignificant, but would have contributed indirectly through nutrients for autochthonous production. Such high short-term BOD rates may overestimate greatly the demand to be satisfied by continuous aeration. (Author's abstract)
W91-12097

PERTURBATIONS IN THE REPRODUCTION CYCLE OF SOME HARPACTICOID COPEPOD SPECIES FURTHER TO THE AMOCO CADIZ OIL SPILL.
Universite de Bretagne-Occidentale, Brest (France). Lab. d'Oceanographie Biologie.
P. Bodin.
Hydrobiologia HYDRB8, Vol. 209, No. 3, p 245-257, February 15, 1991. 12 fig, 1 tab, 48 ref.

Descriptors: *Beach contamination, *Copepods, *France, *Oil pollution, *Oil spills, *Water pollution effects, Amoco Cadiz, Beaches, Long-term studies, Reproduction.

The 'Amoco Cadiz' oil spill occurred in March 1978 off the northwest coast of Brittany (France). The reproductive activity of eight harpacticoid copepod species (Canuella perplexa, Harpacticus flexus, Robertsonia celtica, Amphiascoides debilis, Amphiascoides debilis limicolus, Kliopsyllus constrictus, Paraleptastacus espinalatus, and Asellopsis intermedia) was observed from 1978 to 1984 on three sandy beaches impacted by this oil spill. Species density and mean percentages of ovigerous females and juveniles from the period of maximum pollution were compared to those of one or two years characteristic of the post-recovery period. During the year of maximum pollution (1979) the spring peak of density often came later than normal and was generally lower. The main effect of the pollution was on the reproductive cycle of the species. There often was a delay of 1 month or more in the appearance and peaks of both ovigerous females and juveniles. Moreover, the latter were often absent during strategic months of the usual reproduction period. The recovery generally occurred in 1980 or 1981. (Author's abstract)
W91-12098

SALINITY TOLERANCES OF FOUR SPECIES OF FISH FROM THE MURRAY-DARLING RIVER SYSTEM.
Adelaide Univ. (Australia). Dept. of Zoology.
M. D. Williams, and W. D. Williams.
Hydrobiologia HYDRB8, Vol. 210, No. 1/2, p 145-160, March 1991. 2 fig, 1 tab, 20 ref.

Descriptors: *Australia, *Fish, *Salt tolerance, *Toxicity, *Water pollution effects, Agriculture, Bioassay, Irrigation-return flow, Murray-Darling River Basin, Wastewater disposal.

The fish fauna of the Murray-Darling River system (Australia) is depauperate by world standards, with only 25 species. Some human activities that may induce a gradual increase in salinity may pose a threat to some of these species. The salinity tolerances were measured for four species of small fishes native to the Murray-Darling River system. Slow-acclimation LD50 for salinity were 43.7 + or -1.7 g/L for Craterocephalus stercusmuscarum Gunther, 38.0 + or -1.1 g/L for Hypseleotris klunzingeri (Ogilby), 58.7 + or -0.9 g/L for Retropinna semoni (Weber), and 29.8 + or -0.7 g/L for Melanotaenia splendida (Castelnau). The salinity tolerance of M. splendida was also measured by direct transfer, providing an estimated LD50 (infinite exposure time) of 20.8 g/L, approx 70% of the slow acclimation value. Results suggest that at least adults of the species studied are under no threat from present or foreseeable salinities in the Murray River. (Author's abstract)
W91-12105

LONGITUDINAL DISTRIBUTION OF MACROINVERTEBRATES SUBJECT TO SALINIZATION.
Adelaide Univ. (Australia). Dept. of Zoology.
W. D. Williams, R. G. Taaffe, and A. J. Boulton.
Hydrobiologia HYDRB8, Vol. 210, No. 1/2, p 151-160, March 1991. 7 fig, 5 tab, 41 ref.

Descriptors: *Agricultural runoff, *Australia, *Ecosystems, *Salinity, *Semiarid regions, *Water pollution effects, Agriculture, DECORANA, Environmental effects, Macroinvertebrates, Multivariate analysis, Saline water, Salt tolerance, TWINSPAN.

Although increasing stream and river salinities in semiarid regions have caused concern for some time, there is little information on the extent or nature of environmental change that could result from rising 'instream' salinities. Surveys were made of the macroinvertebrates at several locations on the Blackwood River, Western Australia, and the Glenelg River, Victoria. Both rivers have drainage basins subject to salinization from agricultural practices. The Blackwood River has a clear longitudinal salinity profile in which the upper reaches are more saline than lower ones. Multivariate analysis using DECORANA and TWINSPAN did not reveal relationships between macroinvertebrate community composition and salinity. These results suggest that either the present macroinvertebrate fauna of Australian rivers is more tolerant to salinity than has been assumed or now represents only halotolerant forms derived from a formerly more diverse fauna. (Author's abstract)
W91-12106

REGIONAL CHARACTERISTICS OF LAND USE IN NORTHEAST AND SOUTHERN BLUE RIDGE PROVINCE: ASSOCIATIONS WITH ACID RAIN EFFECTS ON SURFACE-WATER CHEMISTRY.
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5B.
W91-12120

INFLUENCE OF HUMIC SUBSTANCES ON THE AEROBIC DECOMPOSITION OF SUBMERGED LEAF LITTER.
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W91-12129

MONITORING OF THE OVERALL PESTICIDE TOXICITY OF RIVER WATER TO AQUATIC ORGANISMS USING A FRESHWATER SHRIMP, PARATYA COMPRESSA IMPROVISA.
National Inst. for Environmental Studies, Tsukuba (Japan). Regional Environment Div.
For primary bibliographic entry see Field 5A.
W91-12144

MUTAGENICITY OF THE COMPONENTS OF OZONATED HUMIC SUBSTANCE.
Mie Univ. Hospital, Tsu (Japan).
H. Matsuda, Y. Ose, H. Nagase, T. Sato, and H. Kito.
Science of the Total Environment STENDL, Vol. 103, No. 2/3, p 129-140, April 15, 1991. 5 fig, 4 tab, 42 ref.

Descriptors: *Aldehydes, *Ames test, *Humic substances, *Mutagenicity, *Ozonation, *Water pollution effects, Bioassay, Chemical analysis, Halides, Mutagens, Separation techniques, Toxicity, Water treatment.

Eight components of humic substances (p-hydroxybenzaldehyde, syringaldehyde, protocatechuic acid, ferulic acid, syringic acid, benzoic acid, vanillic acid, and resorcinol) were ozonated and tested for mutagenicity using strains of Salmonella typhimurium. Mutagenic activity was determined using strain TA100 both with and without S9 mix for all of the ozonated components. Para-hydroxybenzaldehyde was selected as a model compound to attempt to identify ozonation products. Following ozontaion, products were separated on a silica gel column and eluted with five organic solvents (benzene, chloroform, chloroform-acetone (1:1), acetone and methanol). Chloroform and chloroform-acetone (1:1) fractions showed strong mutagenic activities, so their pentafluorobenzyloxyamine derivatives were investigated by gas chromatography/mass spectrometry. The principal ozonated products were found to be aldehydes, ketones, acids and esters. Five-membered ring compounds such as 2-methyl-1,3-cyclopentanedione in the chloroform-acetone (1:1) fraction were also found. Among the identified products, acetaldehyde, formaldehyde, glyoxal, glyoxylic acid and methylglyoxal, particularly, have been found to be mutagenic in the Ames assay. From these results, it was determined that aldehydes are sources of mutagenicity following ozonation. (VerNooy-PTT)
W91-12150

MUTAGENICITY OF OZONATION AND CHLORINATION PRODUCTS FROM P-HYDROXYBENZALDEHYDE.
Mie Univ. Hospital, Tsu (Japan).
H. Matsuda, Y. Ose, H. Nagase, T. Sato, and H. Kito.
Science of the Total Environment STENDL, Vol. 103, No. 2/3, p 141-149, April 15, 1991. 3 fig, 3 tab, 18 ref.

Descriptors: *Aldehydes, *Ames test, *Chlorination, *Humic substances, *Mutagenicity, *Ozonation, *Water pollution effects, Bioassay, Chemical analysis, Ion exchange, Mutagens, Pollutant identification, Resins, Separation techniques, Water treatment.

When drinking water is chlorinated, organic halides are formed, some of which show mutagenic activity. In this study, p-hydroxybenzaldehyde, a component of soil humic substances, was ozonated and chlorinated; the ether extract and the residue were then subjected to the Ames assay, and muta-

genic activities in Salmonella typhimurium were identified. The nonionic resin CSP800 and the anion exchange resin CHPA25 were used to further separate the mutagenic compounds. Compounds in the water layer were not adsorbed on CSP800 or CHPA25 and exhibited strong mutagenic activity. Ether extracts were analyzed by gas chromatography/mass spectrometry and many chlorinated products were detected (e.g., chlorinated phenols, acetones, acids and esters); these were the same products found in chlorinated effluent from kraft mills or chlorinated humic substances. Phenolic compounds were detected when the added chlorine dose was one-third that of chlorine consumption, but they were not detected in the case of equal and five-fold chlorine doses. In this respect, it is suspected that the ring fission ability of chlorine is stronger than that of ozone. Among the compounds identified, 1,3-dichloro-2-propanone, chloral, 1,1,1,3,3-pentachloro-2-propanone, and tetrachloroethylene have been reported to be mutagenic compounds formed by chlorination; 1,2,3-trichloro-1-propene was also found to be mutagenic. Therefore, using ozonation-chlorination, slightly polar mutagenic compounds. which were the same as those formed by chlorination alone, were produced both from the compound itself and from its ozone decomposition products. (VerNooy-PTT)
W91-12151

COMPARATIVE TOXICITY OF ORGANOTIN COMPOUNDS TO RAINBOW TROUT (ONCORHYNCHUS MYKISS) YOLK SAC FRY.
Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicology.
H. de Vries, A. H. Penninks, N. J. Snoeij, and W. Seinen.
Science of the Total Environment STENDL, Vol. 103, No. 2/3, p 229-243, April 15, 1991. 3 fig, 4 tab, 28 ref.

Descriptors: *Antifoulants, *Fish larvae, *Organotin compounds, *Toxicity, *Trout, *Water pollution effects, Dose-response relationships, Embryonic growth stage, Fish physiology, Histology, Morbidity, Mortality.

The comparative toxicity of various organotin compounds was investigated in early life stages of the rainbow trout. Beginning with yolk sac fry, trout were continuously exposed for 110 days to tributyl (TBTC), triphenyl (TPhTC) or tricyclohexyltin chloride (TCHTC) at concentrations of 0.12 to 15 nM, to trimethyltin chloride (TMTC) at concentrations of 3 to 75 nM or to dibutyl (DBTC) or diphenyltin chloride (DPhTC) at 160 to 4000 nM. The diorganotin compounds DBTC and DPhTC were about three orders of magnitude less toxic than the triorganotin homologs TBTC and TPhTC. Both for DBTC (at 40 ppb) and DPhTC (at 60 ppb), a no-observable-effect concentration (NOEC) was established. Of the triorganotin compounds, TCHTC appeared to be the most toxic, inducing 100% mortality within 1 week at a concentration of 3 nM. Only a few trout survived exposure to 0.6 nM TCHTC for 110 days. TBTC and TPhTC caused acute mortality at a concentration of 15 nM. For both TBTC and TPhTC a NOEC of 0.12 nM was established, corresponding to water concentrations of 40 and 50 ppt, respectively. Histopathological examination revealed depletion of glycogen in liver cells of both di and tri organotin exposed fish, except in the case of TMTC. No signs of toxicity were observed in fish exposed to up to 75 nM TMTC. Atrophy of the thymus, the most prominent sign of toxicity of di and tributyltin compounds in mammalian species, was not observed in early life stages of rainbow trout. Tail melanization was observed in the groups exposed to 3 nM TPhTC, 3 nM TBTC, 800 nM DBTC and 800 nM DPhTC. At the end of the exposure period, resistance to infection was examined by an intraperitoneal challenge with Aeromonas hydrophila, a secondary pathogenic bacterium to fish. Resistance of bacterial challenge was found to be decreased even at the lowest-effect concentration of both di and triorganotin compounds. (Author's abstract)
W91-12154

EFFECT OF SELENIUM PRETREATMENT ON THE ACUTE TOXICITY OF MERCURY IN THE MUSSEL BRACHIDONTES VARIABILIS.
Middle East Technical Univ., Ankara (Turkey). Inst. of Marine Sciences.
For primary bibliographic entry see Field 5D. W91-12161

EVALUATION OF BALTIC HERRING AND ICELANDIC COD LIVER OIL FOR EMBRYO TOXICITY, USING THE JAPANESE MEDAKA (ORYZIAS LATIPES) EMBRYO LARVAL ASSAY.
Cook Coll., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
K. R. Cooper, H. Liu, P. A. Bergqvist, and C. Rappe.
Environmental Toxicology and Chemistry ETOCDK, Vol. 10, No. 6, p 707-714, June 1991. 4 fig, 23 ref. New Jersey Department of Environmental Protection Project No. 01407.

Descriptors: *Cod liver oil, *Fish farming, *Fish food, *Fish oil, *Toxicity, *Toxicology, *Water pollution effects, Bioassay, Biological studies, Chlorinated hydrocarbons, Dioxins, Laboratory methods, Larvae, Lethal limit, Sublethal effects.

Studies were carried out to determine if oils obtained from wild fish populations were contaminated with polychlorinated-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) and, if they were contaminated, would they result in embryo toxicity as measured by the Japanese medaka embryo larval bioassay (ELA). Three fish oils (Baltic herring oil (HO 1); Baltic herring oil spiked with 44 parts per trillion (pptr) of 1,2,3,7,8,9-HxCDD, 120 pptr OCDD and 130 pptr 2,3,7,8-TCDF (HO 2); and a commercially available cod liver oil (CL)) and a corn oil sample were tested for embryo toxicity in a static renewal protocol. The ELA assay was selected due to its sensitivity to biological effects following dioxin and dibenzofuran exposure. Two of the fish oils (HO 1 and HO 2) were from Baltic herring collected from the Gulf of Bothnia, Sweden, and the third was a commercially available Icelandic cod liver oil. The Baltic herring oil contained higher levels of both PCDDs and PCDFs than the cod liver oil. The HO 1 sample resulted in 30 to 90% death, whereas the HO2 sample caused 100% death. The major lesions were hemorrhage, cardiac effects and tissue necrosis. The time to lesion occurrence and the types of lesions were similar to those observed in studies using pure 2,3,7,8-TCDD. The rearing solution control, corn oil control and cod liver oil samples caused no mortality or lesions. The lethality and lesions caused by these oils in the ELA system were similar to those reported in Salmo salter with the M74-syndrome from Sweden. The use of contaminated fish oils, therefore, may be one cause of poor viability in hatchery salmon reared in Sweden, and care should be taken when using naturally occurring fish or fish oils in nondefined foods. (Lantz-PTT)
W91-12163

EFFECTS OF A CONTAMINATED SEDIMENT ON LIFE HISTORY TRAITS AND POPULATION GROWTH RATE OF NEANTHES ARENACEODENTATA (POLYCHAETA: NEREIDAE) IN THE LABORATORY.
Environmental Research Lab., Narragansett, RI.
C. E. Pesch, W. R. Munns, and R. Gutjahr-Gobell.
Environmental Toxicology and Chemistry ETOCDK, Vol. 10, No. 6, p 805-815, June 1991. 2 fig, 2 tab, 46 ref. EPA Contract Nos. 68-03-3236 and 68-03-3529.

Descriptors: *Ecological effects, *Life history studies, *Polychaetes, *Sediment contamination, *Water pollution effects, Connecticut, Growth, Population dynamics, Reproduction, Sublethal effects, Toxicity.

The effects of a highly contaminated sediments on life history traits and population dynamics of the nereid polychaete Neanthes arenaceodentata Moore were assessed in a laboratory experiment. Survival, growth and fecundity were measured for one generation of worms exposed to 40 and 10% Black Rock Harbor, Connecticut (BRH) sediment (a contaminated sediment), 100% reference (REF) sediment from central Long Island Sound (the control) and a no-sediment treatment (to follow progress of pairing and reproduction). The BRH sediment did not affect survival or size of adults or number of broods. Number of eggs per brood appeared to be lower in 40% BRH sediment than 10% BRH or REF sediment, but the difference was not significant (1,397, 1,621 and 1,556 eggs per brood, respectively). However, number of larvae per brood was significantly lower in the 40% BRH sediment than in 10% BRH or REF sediment (363,770 and 850 larvae per brood, respectively). The number of juveniles appeared to be lower in 40% BRH in the other sediment treatments, although the differences were not significant. Size of juveniles did not differ in the sediment treatments. The finite multiplication rate of population increase, gamma, was the same for all treatments. The lack of significant differences but the presence of some trends may indicate that 40% BRH sediment was not a high enough dose to produce significant effects. (Author's abstract)
W91-12165

ASSESSMENT OF METHODS FOR ESTIMATING AQUATIC HAZARDS AT SUPERFUND-TYPE SITES: A CAUTIONARY TALE.
Menzie-Cura and Associates, Inc., Chelmsford, MA.
For primary bibliographic entry see Field 5G. W91-12166

SEASONAL PHYTOPLANKTON COMPOSITION, PRODUCTIVITY AND BIOMASS IN THE NEUSE RIVER ESTUARY, NORTH CAROLINA.
North Carolina Univ., Morehead City. Inst. of Marine Sciences.
For primary bibliographic entry see Field 2H. W91-12172

BUOYANT DENSITY OF CHROMATIUM SP.: ITS EFFECT ON THE BLOOMING AT AN UPPER BOUNDARY OF THE H2S LAYER IN LAKE KAIIKE.
Nagasaki Univ. (Japan). Dept. of Oceanography.
For primary bibliographic entry see Field 2H. W91-12178

SURVIVAL OF INTRODUCED SMALLMOUTH BASS IN LOW-PH LAKES.
Trent Univ., Peterborough (Ontario). Watershed Ecosystems Program.
E. J. Snucins, and B. J. Shuter.
Transactions of the American Fisheries Society TAFSAI, Vol. 120, No. 2, p 209-216, March 1991. 5 tab, 25 ref.

Descriptors: *Acid rain, *Aluminum, *Bass, *Hydrogen ion concentration, *Ontario, *Survival, *Water quality, Copper, Heavy metals, Manganese, Nickel, Population dynamics, Zinc.

The survival of caged overwintering young-of-the-year, free-swimming adult smallmouth bass (Micropterus dolomieui) introduced into five Ontario lakes that varied in pH from 4.9 to 5.9 (winter values), were measured. No hatchery-reared young survived in lakes that ranged in pH from 4.9 to 5.9 and in total Al from 55 to 215 microgm/L. The only lake in which young survived the winter (2-100% survival) had a pH of 5.9 and a total of Al of 34 microgm/L. Survival of overwintering young in the laboratory was high (92-100%) at all pH levels tested (4.6-6.0). Differences in metal (Al, Cu, Zn, Ni, Mn) concentrations may account for survival differences between the field and laboratory and between lakes with similar pH. Adult smallmouth bass were transferred to four of the same lakes (19-24 fish/lake) used for the experiment on young fish. Population size estimates for the introduced adults were obtained from snorkeling surveys conducted during three spawning seasons (1987-1989). Estimated population size, expressed as percentage of the number stocked, was highest (41-55%) in the lake with pH 5.9, low (4-12%) in

the lake with pH, and zero in two lakes with pH 4.9-5.2. (Author's abstract)
W91-12184

COLONIZATION OF A HEADWATER STREAM DURING THREE YEARS OF SEASONAL INSECTICIDAL APPLICATIONS.
Georgia Univ., Athens. Dept. of Entomology.
J. B. Wallace, A. D. Huryn, and G. J. Lugthart.
Hydrobiologia HYDRB8, Vol. 211, No. 1, p 65-76, March 15, 1991. 3 fig, 5 tab, 40 ref. NSF Grants BSR83-16082 and BSR87-18005.

Descriptors: *Aquatic insects, *Colonization, *Ecology, *Headwaters, *Insecticides, *Stream biota, *Water pollution effects, Coweeta Hydrologic Laboratory, Methoxyclor, Midges, North Carolina.

The recolonization by insects of a small headwater stream treated along its entire length with methoxyclor was investigated. Initial treatment of the stream (a first-order stream in 5.5-ha Catchment 54 at Coweeta Hydrologic Laboratory, North Carolina) occurred in December 1985 and resulted in massive insect drift. Taxonomic composition of the drift indicated several responses: (1) some taxa were eliminated; (2) some taxa occurred only sporadically following the initial treatment; and (3) early instars for some taxa showed seasonal occurrences closely resembling known life cycles and flight periods of adults (Groups that provided strong evidence for aerial recolonization included several Ephemeroptera, Plectoptera (Peltoperlidae and Isoperla spp.), and Trichoptera (Parapsyche cardis, Diplectrona modesta, Pycnopsyche spp., and Lepidostoma spp.)); (4) some long-lived taxa survived and exhibited distinct growth through several treatment periods (including Odonata (Lanthus and Cordulegaster), some Ephemeroptera, and some Diptera (Tipulidae, Certopogonidae, and Tanypodineae); and (5) some taxa that were absent at the time of initial treatment appeared during the experiment. Chironomidae dominated the drift in all samples, and the number of genera did not decrease during the three-year treatment period. Of the 27 chironomid genera identified, only Microspectra decreased in proportional abundance during treatment. In contrast, several genera (Coryneura, Meropelopia, Parametriocnemus, and Tvetnia) showed little change in relative abundance. Larsia (Tanypodinae) increased in proportional abundance during the treatment period. (Author's abstract)
W91-12187

ZOOPLANKTON INDUCED DECREASE IN INORGANIC PHOSPHORUS UPTAKE BY PLANKTON IN AN OLIGOTROPHIC LAKE.
Montana State Univ., Bozeman. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-12194

WATER QUALITY: SALINIZATION AND EUTROPHICATION TIME SERIES AND TRENDS IN SOUTH AFRICA.
Water Research Commission, Pretoria (South Africa).
H. M. du Plessis, and M. van Veelen.
South African Journal of Science SAJSAR, Vol. 87, No. 1/2, p 11-16, January/February 1991. 7 fig, 1 tab, 21 ref.

Descriptors: *Eutrophication, *Salinization, *South Africa, *Water pollution effects, *Water quality, *Water quality trends, Industrial development, Irrigation, Mathematical models, Urbanization, Water quality management.

The major water quality problems experienced in South Africa have been identified as salinization and eutrophication. The monitoring of inorganic water quality in South Africa started in earnest during the 1970s when the Department of Water Affairs initiated a regular program of sampling and analysis of surface waters. High year to year variability in salinity and salinity cycles linked to rainfall seasonality precluded the establishment of definite trends in salinization over the past 10 years. Nevertheless, salinity increases did appear to be associated with industrial development and irrigation in several cases where long-term data were available. Studies have indicated that the trend toward eutrophication of water bodies is directly linked to development, especially urban and industrial growth. Of 98 impoundments examined in a 1975 study in South Africa, about half were found to be low in plant nutrients, 11 were heavily eutrophic, and the rest were intermediate. Six of the most eutrophic impoundments received substantial quantities of secondary purified sewage effluents. Mathematical models developed to simulate salinization and eutrophication processes have been useful for water quality management. Effective monitoring systems will also be needed to provide information on the relative importance of drainage areas and water quality variables in the development of water quality management strategies for South Africa. (MacKeen-PTT)
W91-12281

RANDOMIZED TRIAL TO EVALUATE THE RISK OF GASTROINTESTINAL DISEASE DUE TO CONSUMPTION OF DRINKING WATER MEETING CURRENT MICROBIOLOGICAL STANDARDS.
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
For primary bibliographic entry see Field 5F.
W91-12282

WATERBORNE OUTBREAK OF NORWALK VIRUS GASTROENTERITIS AT A SOUTHWEST US RESORT: ROLE OF GEOLOGICAL FORMATIONS IN CONTAMINATION OF WELL WATER.
Centers for Disease Control, Atlanta, GA. Div. of Reproductive Health.
For primary bibliographic entry see Field 2F.
W91-12289

WATER SOURCE AS RISK FACTOR FOR HELICOBACTER PYLORI INFECTION IN PERUVIAN CHILDREN.
Children's Nutrition Research Center, Houston, TX.
P. D. Klein, D. Y. Graham, A. Gaillour, A. R. Opekun, and E. O'Brian Smith.
Lancet LANAAI, Vol. 337, No. 8756, p 1503-1506, June 22, 1991. 2 fig, 3 tab, 16 ref. National Institute of Diabetes and Kidney Diseases Grant Nos. DK 28129, DK 35369, DK 39048, and DK 39919, and DOE/ARS Cooperative Agreement No. 58-7MN1-6-100.

Descriptors: *Drinking water, *Helicobacter, *Lima, *Peru, *Public health, *Water pollution effects, Campylobacter, Economic aspects, Municipal water, Social aspects.

Helicobacter pylori infection is widespread among Peruvian adults by the age of 30, but the age at which children become infected, the prevalence of disease, and the role of socioeconomic status in the epidemiology of infection are now known. The 13-C-urea breath test was used to study the prevalence of infection in 407 Peruvian children from Lima, aged 2 months to 12 years, from families of low and high socioeconomic status. Peruvian children acquire H. pylori early in life and the number of infected individuals increases rapidly with age; overall prevalence was 48%. H. pylori infection was independent of sex, but was highly correlated with socioeconomic status; prevalence of infection was higher among children from low-income families than among those from high-income families (56% vs. 32%, $p = 0.001$). Children whose homes had external water sources were three times more likely to be infected than were those whose homes had internal water sources. Among families with internal water sources, there was no difference in H. pylori infection associated with income. Children from high-income families whose homes were supplied with municipal water were 12 times more likely to be infected than were those from high-income families whose water supply came from community wells. The findings show that the prevalence of H. pylori infection is high among young Peruvian children and that the municipal water supply seems to be an important source of infection among Lima children from families of both low and high socioeconomic status. (Author's abstract)
W91-12290

GENOTOXIC EFFECTS OF THE DRINKING WATER MUTAGEN 3-CHLORO-4-(DICHLOROMETHYL)-5-HYDROXY-2(5H)-FURANONE (MX) IN MAMMALIAN CELLS IN VITRO AND IN RATS IN VIVO.
National Inst. of Public Health, Oslo (Norway). Dept. of Environmental Medicine.
G. Brunborg, J. A. Holme, E. J. Soderlund, J. K. Hongslo, and T. Vartiainen.
Mutation Research MUREAV, Vol. 260, No. 1, p 55-64, May 1991. 6 fig, 35 ref.

Descriptors: *Drinking water, *Genetics, *Mammals, *Mutagens, *Toxicity, *Toxicology, *Water pollution effects, Biological studies, Chlorination, DNA, Sublethal effects.

The potent bacterial mutagen 3-chloro-4(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX), which is formed during chlorination of drinking water and accounts for about one-third of the Ames mutagenicity of tap water, has been studied with respect to its genotoxicity in vitro and in vivo. Treatment with 30-300 microM MX (1 hr) induced DNA damage in a concentration-dependent manner in suspensions of rat hepatocytes, as measured by an automated alkaline elution system. The effect was similar in hepatocytes from PCB-induced and uninduced rats. DNA damage was induced in V79 Chinese hamster cells and in isolated rat testicular cells, at the same concentration level as in hepatocytes. Pretreating testicular cells with diethylmaleate, which depletes 85% of cellular glutathione, had no significant effect on the DNA damage induced by MX. The treatment conditions used in the alkaline elution experiments were not cytotoxic to any of the cell types used, as determined by trypan blue exclusion. V79 cells exposed to 2-5 microM MX (2 hr) showed an increased frequency of sister-chromatid exchanges (SCE) whereas no significant effect on hypoxanthine guanine phosphoribosyl transferase (HGPRT) mutation induction was observed. Higher concentrations (> 10 microM, 2 hr) apparently blocked cell division. The data indicate that MX can react directly with DNA or that MX is metabolized to an ultimate mutagen via some enzyme which is common in mammalian cells. The in vivo experiments showed no evidence of genotoxicity after intraperitoneal (18 mg/kg, 1 hr) or oral (18, 63 or 125 mg/kg, 1 hr) administration of MX, as measured by alkaline elution, in any of the following organs: the pyloric part of the stomach, the duodenum, colon ascendens, liver, kidney, lung, bone marrow, urinary bladder and the testes. In conclusion, MX is a direct-acting genotoxicant in vitro but no in vivo genotoxicity was detected. (Author's abstract)
W91-12291

ACIDIC SNOWMELT EVENT IN A NEW JERSEY STREAM: EVIDENCE OF EFFECTS ON AN INDIGENOUS TROUT POPULATION.
New Jersey Div. of Fish, Game and Wildlife, Lebanon.
W. Stansley, and G. Cooper.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 227-237, October 1990. 4 fig, 2 tab, 44 ref. Federal Aid to Sport Fish Restoration Act Project F-47-R.

Descriptors: *Acid rain, *Acid rain effects, *Path of pollutants, *Snow, *Trout, *Van Campens Brook, *Water pollution effects, Acidification, New Jersey, Snowmelt, Spawning, Species diversity.

Van Campens Brook is a circumneutral stream in northwestern New Jersey that supports reproducing populations of brook trout (Salvelinus fontinalis), brown trout (Salmo trutta) and rainbow trout (Oncorhynchus mykiss). A short-term pH depression occurred in the stream following a snowmelt in the spring of 1984. A stream pH of 4.5 was recorded shortly after the onset of the snowmelt and the pH remained depressed (5.2) a week later. An electrofishing survey conducted in 1985 re-

vealed a near-total absence of 1984 year-class rainbow trout, spring spawners that are highly sensitive to acidity. Brook and brown trout spawning appeared to be unaffected. Rainbow trout reproductive success was good during 1985-87. (Author's abstract)
W91-12293

BRAIN ACHE ACTIVITY STUDIES IN SOME FISH SPECIES COLLECTED FROM A MERCURY CONTAMINATED ESTUARY.
Berhampur Univ. (India). Lab. of Environmental Toxicology.
B. P. Shaw, and A. K. Panigrahi.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 327-334, October 1990. 3 fig, 36 ref.

Descriptors: *Acetylcholine, *Biochemistry, *Brains, *Estuaries, *Mercury, *Water pollution effects, Bioassay, Biological studies, Fish, Fish pathology, Industrial wastewater, Sublethal effects, Tissue analysis, Toxicity.

In an attempt to investigate the impact of the discharge of Hg contaminated effluent from a chlor-alkali industry into the Rushikulya River estuary, brain AChE activity was measured in three fish species, S. sihama, A. nenga and S. argus, sampled from the contaminated water of the estuary. The residual Hg levels in the brain tissue of the fishes were also determined. The maximum brain residual Hg level, 0.702 +/-0.205 mg/kg wastewater, was recorded in S. sihama. The inhibition of the AChE activity observed in that species was as much as 26.48% when compared to the normal enzyme activity. The levels of inhibition observed in the other two fish species, A. nenga and S. argus, were also more than the 10% index level suggested. A significant negative correlation observed between the brain residual Hg levels and the AChE activity levels suggested the use of fish brain AChE measurement as a regular monitoring protocol in assessment of the pollution of aquatic systems by Hg. (Author's abstract)
W91-12298

GILL DAMAGE TO CATFISH, SACCOBRANCHUS FOSSILIS FOLLOWING EXPOSURE TO CHROMIUM.
Industrial Toxicology Research Centre, Lucknow (India).
B. S. Khangarot, and D. M. Tripathi.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 379-390, October 1990. 12 fig, 28 ref.

Descriptors: *Catfish, *Chromium, *Gills, *Heavy metals, *Water pollution effects, Bioassay, Fish pathology, Sublethal effects, Tissue analysis, Toxicity.

Air-breathing catfish, Saccobranchus fossilis, were exposed to 5.6 mg/L of Cr for 7 d under static bioassay conditions. Gill tissue was examined through the scanning electron microscope (SEM) for surface morphological changes. In the control fish, the gill epithelium on primary and secondary lamellae contained distinctive surface features consisting of whorled patterns of microridges (microfolds) with intervening grooves. The microridges and grooves on the primary lamellae surface were regular in their architecture; whereas, the microridges of secondary lamellae were further apart and discontinuous. Small pores were observed on primary and secondary lamellar epithelium. SEM study of chromate exposed gill morphological data revealed that hyperplastic reaction start locally in the primary and the secondary lamellar epithelium. It appears that the hyperplastic results from direct chromate damage to the epithelial cells. Other gill damages were edema, fusion of secondary gill lamellae and degeneration of epithelial cells. Marked ultrastructural alterations in the pattern of microridges and intervening grooves, and swelling of primary and secondary epithelial cells were evident at 5.6 mg/L of Cr level. (Author's abstract)
W91-12302

RESIDUAL DAMAGE TO HEMATOPOIETIC SYSTEM IN MICE EXPOSED TO A MIXTURE OF GROUNDWATER CONTAMINANTS.
National Toxicology Program, Research Triangle Park, NC.
H. L. Hong, R. S. H. Yang, and G. A. Boorman.
Toxicology Letter TOLED5, Vol. 57, No. 1, p 101-111, June 1991. 1 fig, 4 tab, 53 ref.

Descriptors: *Groundwater pollution, *Hematopoitic system, *Toxicity, *Toxicology, *Water pollution effects, Biological studies, Bone marrow, Hazardous wastes, Mice, Public health, Radiation, Sublethal effects, Tissue analysis.

To assess the potential health effects of chemically contaminated groundwater, a toxicological program was initiated using a mixture of 25 frequently detected groundwater contaminants derived from hazardous waste disposal sites. As part of this program, myelotoxicity studies were conducted. Bone marrow parameters were examined in mice exposed to 0, 1, 5, or 10% of a simulated chemical mixture stock solution of groundwater contaminants in drinking water for 108 days. Mice treated with 5 or 10% of the chemical mixture stock solution for 108 days showed suppressed marrow granulocyte macrophage progenitors (CFU-GM); however, this suppression disappeared to 10 weeks following the cessation of treatment. The possible toxicological interaction of groundwater contaminants and radiation on hematopoiesis was investigated by using the number of bone marrow CFU-GM as an index. When mice were exposed to 200 rads whole body irradiation at 2 and 9 weeks during this 10 week recovery period, the combined treatment (i.e., chemical mixture followed by irradiation) group showed a significantly slower recovery of bone marrow progenitors as compared with the control group (i.e., radiation but without prior chemical mixture treatment). This study showed that even 10 weeks after the cessation of the chemical mixture treatment, when all hematological parameters were normal, residual effects may still be demonstrated as lower progenitor cell numbers following irradiation. Thus, residual damage of hematopoiesis in mice exposed to groundwater contaminants for 108 days renders the mice more sensitive to subsequent irradiation-induced injury. (Author's abstract)
W91-12306

EMERALD LAKE WATERSHED STUDY: INTRODUCTION AND SITE DESCRIPTION.
California State Air Resources Board, Sacramento. Research Div.
For primary bibliographic entry see Field 5B.
W91-12329

TRANSFORMATION BY BACTERIAL COMMUNITIES OF ORGANIC MATTER SECRETED BY LIVING PHYTOPLANKTON (IN RUSSIAN).
Moscow State Univ. (USSR).
For primary bibliographic entry see Field 2H.
W91-12373

PHYTOPLANKTON AND CHEMICAL COMPOSITION OF THE WATERS OF LAKE JACK LONDON (MAGADAN PROVINCE) (IN RUSSIAN).
Akademiya Nauk SSSR, Magadan. Inst. Biologicheskikh Problem Severa.
For primary bibliographic entry see Field 2H.
W91-12374

EFFECT OF SULFATE IONS ON GROWTH AND THE EFFICIENCY OF PRIMARY PHOTOSYNTHETIC REACTIONS IN A SCENEDENSMUS QUADRICAUDA CULTURE (IN RUSSIAN).
Moscow State Univ. (USSR).
S. E. Plekhanov, I. M. Al'-Sal'man, and M. M. Telitchenko.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 26, No. 6, p 37-42, 1990. 4 fig, 11 ref. English summary.

Descriptors: *Acid rain effects, *Algae, *Chlorophyta, *Ecological effects, *Photosynthesis, *Sulfates, *Water pollution effects, Algal growth, Growth rates, Plant physiology, Salinity, Sulfur compounds.

Scendesmus quadricauda cultures were grown under saline conditions (with sulfate-ions) over two time intervals: 5-13 and 13-19 days. Results showed that the growth rate was independent of sulfate concentration. A high growth rate in the period of 13-19 days was accompanied by a sharp decrease in the efficiency of primary photosynthetic reactions. It was established that the optimum time required to affect any direct salt action on the photosynthetic system was 1-1.5 minutes. The inhibitory action of long-time sulfate exposure was related to the influence of sulfate ions on the photosynthetic membranes. (Author's abstract)
W91-12376

VARIATION OF PHYTOPLANKTON GROWTH CHARACTERISTICS UNDER THE INFLUENCE OF LIGHT AND TEMPERATURE (IN RUSSIAN).
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2H.
W91-12377

BIOCHEMICAL VARIATION IN THE HEMOLYMPH OF BLACK SEA BIVALVES IN REACTION TO TOXIC SUBSTANCES (IN RUSSIAN).
Akademiya Nauk SSSR, Moscow. Natural Environment and Climate Monitoring Lab.
M. S. Galina.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 26, No. 6, p 56-59, 1990. 2 fig, 10 ref. English summary.

Descriptors: *Bioindicators, *Bivalves, *Black Sea, *Hydrogen sulfide, *Oil pollution, *Water pollution effects, Aquatic animals, Biological studies, Blood, Enzymes, Oil, Tissue analysis, Toxicity, USSR.

Black Sea mussel hemolymph was used as a bioindicator of water pollution (oil and hydrogen sulfide). The most sensitive parameters included: transaminase activity and general protein concentration in the blood of the Black Sea mussel. (Author's abstract)
W91-12378

FORMATION OF THE HYDROCHEMICAL REGIME IN SMALL RESERVOIRS OF THE STEPPES IN THE DNEPR REGION (IN RUSSIAN).
A. I. Korableva, and T. N. Kovtun.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 26, No. 6, p 60-65, 1990. 4 tab, 11 ref. English summary.

Descriptors: *Eutrophic lakes, *Eutrophication, *GRES-2 Reservoir, *Karachunovskoe Reservoir, *Reservoirs, *Water pollution effects, *Yushnoe Reservoir, Algal blooms, Algal growth, Biological oxygen demand, Bottom sediments, Chlorides, Mineralization, Organic matter, Oxidation, Phosphates, Phosphorus, USSR.

The Karachunovskoe, Yushnoe and GRES-2 reservoirs located in the steppe zone of the Ukrainian, USSR, showed considerable eutrophication due to anthropogenic effects. Water mineralization in reservoirs increased by 110-400 mg, the content of phosphates increased more than six fold, 5-day biological oxygen demand doubled, chlorides content doubled, and permanganate water oxidation susceptibility decreased. Protein components in organic matter and bottom deposits also increased. (Mertz-PTT)
W91-12379

EFFECT OF THE DETERGENT 'BIO-S' ON EUGLENA IN A CONTAMINATED WATER MEDIUM (IN RUSSIAN).
Moscow State Univ. (USSR).
K. Vasternak, and S. A. Ostroumov.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 26, No. 6, p 78-79, 1990. 1 tab, 9 ref. English summary.

Descriptors: *Euglena, *Euglenophyta, *Toxicity, *Water pollution effects, Bioindicators, Deter-

gents, Indicators, Lethal limit, Mortality, Soaps, Sulfur compounds.

The effects of the detergent Bio-S (in concentrations of 0.01-0.5 g/L) on Euglena gracilis Klebs were studied. Concentrations of 0.01 g/L and 0.1 g/L produced no significant effects. However, Bio-S at a concentration of 0.5 g/L completely inhibited growth of the culture and induced death of the Euglena cells. (Author's abstract)
W91-12381

MESOCOSM STUDIES ON THE INFLUENCE OF PHOSPHATE ENRICHMENT ON AMMONIUM AND NITRATE FLUX IN AN OLIGOTROPHIC LAKE.
Montana State Univ., Bozeman. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-12385

INHIBITION OF AGGREGATION-FACTOR-INDUCED RAS GENE EXPRESSION IN THE SPONGE GEODIA CYDONIUM BY DETERGENT-POLLUTED SEAWATER: A SENSITIVE BIOLOGICAL ASSAY FOR LOW-LEVEL DETERGENT POLLUTION.
Institut fur Physiologische Chemie, Abteilung Angewandte Molekularbiologie, Universitat, Duesbergweg 6, W-6500 Mainz, Germany.
For primary bibliographic entry see Field 5A.
W91-12389

MULTI-YEAR DISTRIBUTION PATTERNS OF NUTRIENTS WITHIN THE NEUSE RIVER ESTUARY, NORTH CAROLINA.
East Carolina Univ., Greenville, NC. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W91-12390

RESPONSE OF A MARINE SHALLOW-WATER SEDIMENT SYSTEM TO AN INCREASED LOAD OF INORGANIC NUTRIENTS.
Goeteborg Univ. (Sweden). Dept. of Zoology.
P. Nilsson, B. Jonsson, I. L. Swanberg, and K. Sundback.
Marine Ecology Progress Series MESEDT, Vol. 71, No. 3, p 275-290, April 30, 1991. 12 fig, 1 tab, 70 ref.

Descriptors: *Estuarine sediments, *Eutrophication, *Food chains, *Marine bacteria, *Marine environment, *Water pollution effects, Aquatic bacteria, Biomass, Carbon, Chlorophyta, Copepods, Cyanophyta, Estuaries, Estuarine environment, Nitrogen, Oxygen, Phosphorus, Productivity.

An outdoor experimental system was used to investigate the effect of an increased load of inorganic nitrogen and phosphorus on the lower trophic levels of the food web of a shallow-water sandy sediment. Estimates of structural changes were based on relationships between the biomass of autotrophs, heterotrophic bacteria and meiofauna and their qualitative composition. Effects on the functions of the sediment community were assessed by measuring primary and bacterial productivity and meiofaunal grazing rates using radiolabelling, as well as by measuring changes in oxygen and nutrient fluxes, and carbon pools. The sediment system responded within 2-3 weeks to the nutrient enrichment. Meiofauna biomass increased, resulting in the higher relative importance of oligochaetes and harpacticoid copepods. Primary productivity increased faster than meiofaunal grazing. Diatoms and filamentous cyanobacteria were favored by the increased nutrient levels. The stimulated photosynthetic activity had a negative feedback on the producing sediment layer. Stimulated growth of the filamentous green alga Enteromorpha clathrata resulted in a biomass of about 2 g C/sq m after 4 weeks, which was more than 2 times the biomass of microautotrophs living in the sediment. Although autotrophic organisms were more important carbon sources than bacteria for meiofauna, the impact of grazing on microautotrophs was small. However, grazing may be important in regulating bacterial growth. In terms of biomass, the addition of nutrients led to a dominance of meiofauna, but in terms of productivity, autotrophs predominated. Therefore, during the initial phase of increasing nutrient levels, the entire sediment system was dominated by autotrophic processes. (Mertz-PTT)
W91-12391

CYCLING OF NUTRIENT ELEMENTS IN THE NORTH SEA.
Hamburg Univ. (Germany, F.R.). Inst. fuer Biochemie und Lebensmittelschemie.
For primary bibliographic entry see Field 2L.
W91-12393

EXPERIMENTAL EVIDENCE FOR NITROGEN LIMITATION IN A NORTHERN OZARK STREAM.
Missouri Univ.-Columbia. School of Natural Resources.
For primary bibliographic entry see Field 2E.
W91-12396

AMMONIUM STIMULATION OF DARK CARBON FIXATION AS AN INDICATOR OF NITROGEN DEFICIENCY IN PHYTOPLANKTON: POTENTIAL ERRORS CAUSED BY AMMONIUM-OXIDIZING BACTERIA.
Montana State Univ., Bozeman. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-12424

COMPARISON OF PERIPHYTIC ALGAL BIOMASS AND COMMUNITY STRUCTURE ON SCIRPUS VALIDUS AND ON A MORPHOLOGICALLY SIMILAR ARTIFICIAL SUBSTRATUM.
Brandon Univ. (Manitoba). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-12426

EFFECTS OF OZONATION ON MUTAGENIC ACTIVITY OF POLYCYCLIC AROMATIC HYDROCARBONS.
Lyon-1 Univ. (France). Dept. of Toxicology.
For primary bibliographic entry see Field 5F.
W91-12427

IMPACT OF AN ORGANOPHOSPHATE HERBICIDE (GLYPHOSATE(R)) ON PERIPHYTON COMMUNITIES DEVELOPED IN EXPERIMENTAL STREAMS.
Victoria Univ. (British Columbia). Dept. of Biology.
A. P. Austin, G. E. Harris, and W. P. Lucey.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 29-35, July 1991. 2 fig, 1 tab, 17 ref. Science Council of British Columbia Grant 90 (RC-15), Natural Sciences and Engineering Research Council of Canada Grant A9537.

Descriptors: *Eutrophication, *Glyphosate, *Herbicides, *Organophosphorus pesticides, *Periphyton, *Phosphorus, *Water pollution effects, Algae, Artificial watercourses, British Columbia, Humpback Lake, Plant growth, Toxicity.

Although the herbicide glyphosate (N-phosphonyl glycine, Roundup/Vision) has been hypothesized to cause decreased photosynthesis in periphyton, it also may serve as a phosphorus source later, resulting ultimately in increased growth of phytoplankton (i.e., eutrophication). Low-level concentrations (1-300 microgram/L) were employed to investigate (1) herbicide toxicity and (2) eutrophication effects on periphyton species composition and biomass accrual in field-based stream-troughs. The studies were conducted near Humpback Lake, British Columbia. Diatoms were dominant in all treatments and troughs, but biovolume was dominated by Chlorophyta. Community dominance patterns both numerical and volumetric, did not appear to exhibit a change over the 120-day period of observation. Adnate diatoms were the early colonizers and stalked and chain-forming, vertically-oriented diatoms formed the initial canopy. Mature communities consisted of a diatom understory and chlorophyte canopy. In the present study, 22 days after colonization, community architecture consisted of Synedra, Tabellaria, Fragilaria, and Achnanthes, a physiognomic pattern resembling that observed in laboratory stream studies. The addition of glyphosate to a periphyton community appeared to have little effect on subsequent successional patterns. The post-application increases in diatom standing crop noted in earlier studies using glyphosate could have been the result of glyphosate-induced eutrophication. (Rochester-PTT)
W91-12429

EFFECTS OF A DIAZINON FORMULATION ON UNIALGAL GROWTH RATES AND PHYTOPLANKTON DIVERSITY.
Southwest Missouri State Univ., Springfield. Dept. of Biology.
S. M. Doggett, and R. G. Rhodes.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 36-42, July 1991. 2 tab, 15 ref.

Descriptors: *Algal growth, *Diazinon, *Insecticides, *Pesticides, *Phytoplankton, *Species diversity, *Toxicology, *Water pollution effects, Chlorophyta, Cyanophyta, McDaniel Lake, Missouri, Plant growth, Population dynamics, Toxicity.

Few reports are available on the effects of the organophosphorus insecticide Diazinon on nontarget aquatic organisms and even less is known about its effect on algal growth and phytoplankton diversity. A study was conducted (1) to determine the effects of a Diazinon formulation on the growth rates of three widely distributed species of freshwater algae and (2) to ascertain the effects of this formulation on the diversity of a natural phytoplankton assemblage. Monocultures of Chlorella pyrenoidosa (normal and high-temperature strains), Selenastrum capricornutum, and Synechococcus leopoliensis and natural assemblages obtained from McDaniel Lake (north of Springfield, Missouri) were used in the experiments. In unialgal cultures, C. pyrenoidosa (normal) and Selenastrum capricornutum appeared to be stimulated by lower concentrations of Diazinon, but all algae had significant suppression of growth at higher concentrations (> 10 mg/L). The results of the diversity study illustrate the potential for profound impacts on phytoplankton population dynamics. An inverse relationship existed between the formulation concentration and species diversity, and the inhibition of the blue-green algal component was particularly apparent. Two genera of algae, Chlorella and Franceia, were stimulated by all concentrations (range: 1-40 mg/L). The results of this investigation indicate that further research and monitoring are essential to accurately assess the potential risks to natural phytoplankton communities posed by Diazinon. (Rochester-PTT)
W91-12430

TOXIC EFFECT OF PARATHION ON MOINA MACROCOPA METABOLISM.
Instituto Politecnico Nacional, Mexico City. Escuela Nacional de Ciencias Biologicas.
L. Martinez-Tabche R., R. Alfaro Y., E. Sanchez-Hidalgo, and I. Galar C.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 51-56, July 1991. 2 tab, 14 ref.

Descriptors: *Crustacea, *Insecticides, *Metabolism, *Parathion, *Toxicity, *Water pollution effects, *Waterfleas, Ankistrodesmus, Bioassay, Globin, Glucose, Hemoglobin, Krebs cycle, Mexico, Moina, Proteins.

Parathion can alter metabolism by stimulation or inhibition of enzymatic systems. Studies on the toxicity of this insecticide to freshwater organisms have concentrated on fish and have yielded only limited information on the effects of parathion on invertebrates. The present study aimed to determine the effect of parathion exposure on the metabolism of Moina macrocopa, a daphnid cladoceran that is a natural component of freshwater

ecosystems in Mexico and a major source of food for several species of fish. M. macrocopa were cultured from parthenogenetic females and fed a diet of Ankistrodesmus falcatus. The calculated 48-hr LC50 value of parathion was 0.94 microgram/L (95% confidence interval: 0.74-1.14). This result is based on the initial amount of insecticide added to reconstituted water. The no-observable-effect level was 0.13 microgram/L, indicating that M. macrocarpa is very sensitive to parathion. The hemoglobin levels in the animals increased even when dissolved oxygen was maintained within the range of air-saturated water. Probable inhibition of Krebs cycle enzymes might account for the decreased oxygen consumption. An increase in soluble protein level was observed, possibly as a result of induction of globin synthesis, but the precise mechanism and respective relationship involving raising the glucose and hemoglobin levels combined with a rise in protein content induced in M. macrocarpa by parathion needs in-depth investigation. (Rochester-PTT)
W91-12431

EFFECT OF OIL-CONTAMINATED SEDIMENT ON THE LONGHORN SCULPIN (MYOXOCEPHALUS OCTODECEMSPINOSUS) FOLLOWING CHRONIC EXPOSURE.
Memorial Univ. of Newfoundland, St. John's. Dept. of Biology.
R. A. Khan.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 63-69, July 1991. 2 tab, 16 ref. Natural Sciences and Engineering Research Council of Canada Grant OSC 95.

Descriptors: *Animal parasites, *Chronic toxicity, *Fish, *Oil pollution, *Sculpin, *Sediment contamination, *Toxicology, *Water pollution effects, Bioassay, Marine sediments, Newfoundland, Oil, Reproduction, Spawning, Toxicity, Trichodina.

Fish inhabiting the marine littoral zone usually are exposed to a variety of pollutants, including petroleum originating from urban and industrial waste. A study was conducted to determine the effects of oil-contaminated sediment, following long-term exposure, on the body weight, organs, tissues and parasitofauna of the longhorn sculpin (Myoxocephalus octodecemspinosus). Adult longhorn sculpins, mostly females, were collected in the field and held in 300-L aquaria. Fish were exposed to either uncontaminated or contaminated sediment in 300-L aquaria with a sea water flow of 5 L/min. The contaminated sediment consisted of 1 L of crude oil and 45 kg of washed sand; the crude oil came from the Hibernia field (Newfoundland) and had an estimated hydrocarbon concentrate was estimated at 2-3 mg/g. Subtle changes were apparent in the oil-treated longhorn sculpins, including spawning occurring 5-6 wk later than controls or failure to spawn at all. No external lesions were observed on oil-treated fish. The number of Trichodina sp. on the gills was significantly greater ($P < or = 0.05$) in the oil-treated fish than in the controls. This increase in numbers was associated with hyperplasia in the gill lamellae and excessive mucus secretion. No tissue abnormalities were apparent in the liver, heart, kidney, stomach, intestine, or ovary. No differences were observed in the melting and freezing point temperatures between the two groups of fish. In a second study, indices of the gonads in female oil-treated fish were significantly less compared to those of control fish. Increased mortality was observed in longhorn sculpins exposed to oil-contaminated sediment, but no external lesions were apparent and post-mortem changes caused by freezing precluded an adequate histopathological examination. (Rochester-PTT)
W91-12432

REPRODUCTIVE VALUE AND THE COST OF REPRODUCTION IN DAPHNIA CARINATA AND ECHINISCA TRISERIALIS (CRUSTACEA: CLADOCERA) EXPOSED TO FOOD AND CADMIUM STRESS.
Delhi Univ. (India). Dept. of Zoology.
T. Chandini.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 76-83, July 1991. 16 ref. 2 fig, 2 tab.

Descriptors: *Cadmium, *Cladocera, *Cost of reproduction hypothesis, *Food stress, *Reproduction, *Toxicity, *Water pollution effects, Animal behavior, Daphnia, Echinisca, Population dynamics.

Organisms vary in terms of when they stop growth and begin to breed; behavior in this regard is an important criterion of fitness. The effects of food and cadmium stress on the Reproductive Value (RV) and the Residual Reproductive Value (RRV) of the two cladocerans Echinisca triserialis and Daphnia carinata were investigated. A 'cost of reproduction' hypothesis was tested to determine whether energy invested by organisms in reproduction at a particular time could affect their future survival and reproduction. The trends in RV values were widely different for the two species. In E. triserialis the RV value was related to both food and Cd toxicity. The RRV also showed nearly identical trends in relation to food and cadmium stress. The RV trends for D. carinata differed in that they lacked peaks observed in the curves for E. triserialis except for one small peak in the controls. The trend for RRVs was similar. Populations at almost identical Cd-food levels showed a lower RV in relation to age than the controls. Both Cd and food stress and their synergistic interaction reduced the reproductive value at birth significantly. The cost of reproduction hypothesis was not supported strongly by this study, which produced varying results of different levels of statistical significance. (Rochester-PTT)
W91-12434

FACTORS RESPONSIBLE FOR RETARDING THE EUTROPHICATION RATE OF SOME MESOTROPHIC LOWLAND LAKES IN N.E. POLAND.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
A. Hillbricht-Ilkowska.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 75, No. 4, p 447-459, 1990. 6 fig, 5 tab, 23 ref.

Descriptors: *Cycling nutrients, *Eutrophication, *Limiting nutrients, *Limnology, *Poland, *Water pollution effects, Chlorophyll a, Lake Hancza, Mesotrophic lakes, Particulate matter, Phosphorus, Water pollution sources.

There are many factors that affect directly or indirectly the rates of supply, uptake, and cycling of biologically available forms of phosphorus in lake ecosystems and therefore retard or accelerate eutrophication. The chemical composition of watershed waters supplying 13 mesotrophic lakes in northeastern Poland was examined during the summer; surface and bottom waters of the lakes also were studied. The lakes are in the Suwalski Landscape Park, a typical postglacial lake district. The deepest of the lakes is Lake Hancza (maximum depth, 108.5 m; summer total phosphorus (TP) content less than 0.050 mg/l; chlorophyll $a < or = 5$ microgram/l, and secchi depth $> or = 2.5$ m). Although the yearly TP loading equals or exceeds the permissible value, the lakes have maintained their mesotrophic features for 20 to 30 yr. P sorption to allochthonous inorganic material and decalcification processes in the lakes probably account for this situation, because there are strong differences between the chemical content of supplying waters and the lake water and because there is a considerable enrichment of P on sestonic particles. As a consequence of the low bioavailability of P, the midsummer amount of chlorophyll a is lower than predicted from the 'TP-chlorophyll a' relations found for P-limited lakes. (Author's abstract)
W91-12445

DISTRIBUTION AND SEASONAL ABUNDANCE OF BENTHIC MACROINVERTEBRATES IN LAKE NAINI TAL, U.P., INDIA.
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
P. K. Gupta, and M. C. Pant.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 75, No. 4, p 493-506, 1990. 11 fig, 4 tab, 24 ref.

Descriptors: *Benthic fauna, *Eutrophication, *India, *Lake Naini Tal, *Lake restoration, *Limnology, *Water pollution effects, Biomass, Macroinvertebrates, Midges, Mollusks, Tourism, Tubificids.

Lake Naini Tal (area 48 ha, mean depth 16.2 m, elevation above sea level 1937 m) is a major tourist attraction of the Kumaun Region, Uttar Pradesh, in the Himalaya of northeast India. In the recent past the lake has become seriously polluted because the disposal of wastes continues unabated. A total of 30 taxa of benthic macroinvertebrates were collected from Lake Naini Tal between October 1977 and September 1978. Of these, Chironomus plumosus and Tubifex tubifex were dominant numerically, whereas Viviparus bengalensis (Mollusca) had the greatest density and biomass. The population and the biomass declined with increasing water depth down to 7 m; below 7 no individuals were found. The pollution appears to have caused 'desertification' of the profundal zone. To restore the lake it will be necessary to employ two strategies: (1) reduce external nutrient loading and (2) control internal ecological processes. (Rochester-PTT)
W91-12447

DISTRIBUTION OF PERKINSUS MARINUS IN GULF COAST OYSTERS: ITS RELATIONSHIP WITH TEMPERATURE, REPRODUCTION, AND POLLUTANT BODY BURDEN.
Texas A and M Univ., College Station. Dept. of Oceanography.
E. A. Wilson, E. N. Powell, M. A. Craig, T. L. Wade, and J. M. Brooks.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 75, No. 4, p 533-550, 1990. 3 fig, 7 tab, 51 ref. NOAA Ocean Assessments Grant 50-DGNC-5-00252 and NOAA Sea Grant College Program Grant NA85AA-D-FG128.

Descriptors: *Animal parasites, *Gulf of Mexico, *Oysters, *Parasites, *Reproduction, *Temperature effects, *Water pollution effects, Bioassay, Bioindicators, Hydrocarbons, Pesticides, Pollutant identification, Tissue analysis.

Perkinsus (=Dermocystidium) marinus is a common endoparasitic protozoan in the American oyster, Crassostrea virginica in the Gulf of Mexico, where it causes high mortality in market-size oysters each year. Oysters from 48 Gulf of Mexico sites were examined for presence and infection intensity of P. marinus as part of the National Oceanographic and Atmospheric Administration's Status and Trends Mussel Watch Program. Prevalence exceeded 75% at 25 sites. Infection intensity did not vary with sex or reproductive stage. Latitude, total polynuclear aromatic hydrocarbon (PAH) content and industrial and agricultural land use significantly affected the parasite's distribution. PAH and pesticide concentrations were dependent latitudinally, suggesting an impact of spawning frequency on uptake and depuration. P. marinus analysis complements the use of pollutant body burden for determining change in environmental quality because it responds differently from pollutant body burden to the biology and ecology of the oyster. (Author's abstract)
W91-12448

PRIMARY PRODUCTION OF PHYTOPLANKTON IN AN OLIGO-MESOTROPHIC LAKE.
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W91-12472

WEAK COUPLING OF BACTERIAL AND ALGAL PRODUCTION IN A HETEROTROPHIC ECOSYSTEM: THE HUDSON RIVER ESTUARY.
Institute of Ecosystem Studies, Millbrook, NY.
For primary bibliographic entry see Field 2L.
W91-12484

SPATIAL AND TEMPORAL VARIABILITIES OF HYPOXIA IN THE RAPPAHANNOCK RIVER, VIRGINIA.
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5B.
W91-12495

SUMMER OXYGEN DEPLETION IN A DIKED NEW ENGLAND ESTUARY.
Cape Cod National Seashore, South Wellfleet, MA.
For primary bibliographic entry see Field 2L.
W91-12496

CHRONIC TOXICITY OF BENZENE ON ENZYMES IN THE INTERTIDAL CLAM GAFRARIUM DIVARICATUM (GMELIN).
Institute of Science, Bombay (India). Dept. of Environmental Sciences.
B. Kulkarnri.
Proceedings of the Indian National Science Academy PIBSBB, Vol. 56, No. 5/6, p 425-428, 1990. 1 tab, 15 ref.

Descriptors: *Benzene, *Clams, *Enzymes, *Toxicity, *Water pollution effects, Animal metobolism, Biochemistry, Intertidal areas, Organic compounds.

Specific activities of aspartate aminotransferase, alanine aminotransferase, acid and alkaline phosphatases were determined in the hepatopancreas, gill, mantle and adductor muscle of the intertidal clam Gafrarium divaricatum after exposure to 2.5 and 5.0 mg/L benzene for one month. Specific activities aminotransferases and phosphatases decreased in all the tissues except that the activities of alanine aminotransferase and acid phosphatase were elevated in the hepatopancreas. (Author's abstract)
W91-12513

SEDIMENT AND WATER AS SOURCES OF NITROGEN AND PHOSPHORUS FOR SUBMERGED ROOTED AQUATIC MACROPHYTES.
Auckland Univ. (New Zealand). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-12515

SUBLETHAL EFFECTS AND BIOACCUMULATION OF CADMIUM, CHROMIUM, COPPER AND ZINC IN THE MARINE AMPHIPOD ALLORCHESTES COMPRESSA.
Australian Nuclear Science and Technology Organisation, Sutherland.
M. Ahsanullah, and A. R. Williams.
Marine Biology MBIOAJ, Vol. 108, No. 1, p 59-65, February 1991. 5 fig, 4 tab, 28 ref.

Descriptors: *Amphipods, *Bioaccumulation, *Cadmium, *Chromium, *Copper, *Path of pollutants, *Sublethal effects, *Water pollution effects, *Zinc, Biomass, Marine life, Mortality, Sea grasses, Toxicity.

The marine amphipod Allorchestes compressa Dana, fed on the sea grass Heterozostera tasmanica, was exposed to sublethal concentrations of Cd, Cr, Cu and Zn for 4 wk in flowing sea water, and the concentrations producing the minimum detectable decreases (the minimum effect concentrations, MECs) in average weight, survival and biomass (average weight x survival proportion) were estimated by interpolation from regression models. Survival and biomass were more sensitive than average weight as indicators of sublethal effects. The lowest values of MEC for Cd, Cr, Cu and Zn were 11, > 250, 3.7 and 99 microgm/L, respectively. For Cu, this value fell below the minimum risk concentration (MRC) calculated from acute toxicity tests (LC-50) and application factors (AF); for Cd, the MEC was similar to the MRC; for Cr and Zn, the MECs were well above the MRCs. The metal concentrations in the amphipods at the MECs were 46, >46, 364 and 139 microgm/gm dry weight for Cd, Cr, Cu and Zn, respectively. Accumulation of the nutrient metals (Cr, Cu and Zn) showed some evidence of metabolic regulation, but the non-nutrient Cd was accumulated without regulation until the amphipods died. In general, those metals that were more highly accumulated by the amphipods were the more toxic. (Author's abstract)
W91-12518

NITRATE TOXICITY TO PENAEUS MONODON PROTOZOEA.
James Cook Univ. of North Queensland, Townsville (Australia). Sir George Fisher Centre for Tropical Marine Studies.
P. R. Muir, D. C. Sutton, and L. Owens.
Marine Biology MBIOAJ, Vol. 108, No. 1, p 67-71, February 1991. 2 fig, 3 tab, 36 ref.

Descriptors: *Nitrates, *Protozoa, *Toxicity, *Water pollution effects, Aquaculture, Bioassay, Mortality, Physiological ecology, Tissue analysis.

Increased levels of nitrate occur in natural waters due to pollution, and in aquaculture systems from nitrification and addition of microalgal cultures for feeding. Static bioassays showed that significant mortality of larval Penaeus monodon (Febricius) occurred within 40 h at nitrate concentrations as low as 1 mg NO3(-)/L. Sublethal effects of this concentration resulted in changes to ganglionic neuropiles and muscles. At higher concentrations (10 and 100 mg NO3(-)/L), additional tissues were affected including the hypodermis, midgut and proventriculus. This is the first report of toxicity to a marine organism of nitrate at concentrations normally present in enclosed sea water and mariculture systems. The results are discussed in terms of management of culture systems and of natural marine ecosystems containing elevated levels of nitrate. (Author's abstract)
W91-12519

SPECIES-SPECIFIC SEDIMENTATION AND SINKING VELOCITIES OF DIATOMS.
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
For primary bibliographic entry see Field 2L.
W91-12520

UPTAKE OF CADMIUM IN TROPICAL MARINE LAMELLIBRANCHES, AND EFFECTS ON PHYSIOLOGICAL BEHAVIOUR.
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
For primary bibliographic entry see Field 5B.
W91-12521

CERIODAPHNIA BIOASSAYS OF CUYAHOGA RIVER SEDIMENTS, UPSTREAM AND DOWNSTREAM OF THE AKRON WATER POLLUTION CONTROL STATION.
Akron Univ., OH. Dept. of Biology.
R. S. Harmon, and J. H. Olive.
Ohio Journal of Science OJSCA9, Vol. 91, No. 3, p 112-117, June 1991. 3 fig, 2 tab, 26 ref.

Descriptors: *Bioassay, *Chlorination, *Cuyahoga River, *River sediments, *Toxicity, *Wastewater treatment, *Water pollution effects, *Water pollution sources, Akron, Algae, Daphnia, Erosion, Ohio, Water pollution control.

The toxicity of sediments collected from depositional and erosional substrates at two locations on the Cuyahoga River in northeastern Ohio was compared. Upstream and downstream locations from the Akron Water Pollution Control Station (Akron WPCS) were selected to evaluate effects of the Akron WPCS effluent on sediment toxicity. Seven-day Ceriodaphnia dubia bioassays were conducted on sediment elutriates. The no-observed effect concentrations (NOECs) were determined for survival and reproduction for each sample collected. The results indicated that sediment collected upstream from the Akron WPCS were more toxic than those collected downstream. Chlorine released with the WPCS effluent may oxidize possible contaminants resulting in lower sediment toxicity downstream. Sediments from erosional substrates were more toxic than those from depositional substrates at both locations. Erosional substrates, in contrast to depositional substrates, had small inorganic particles and contained epilithic algal/microbial mats. These factors probably influenced the concentration of contaminants. (Author's abstract)
W91-12522

REMOVAL OF PHOSPHORUS AND NITROGEN BY RUNOFF AND SURFACE DRAINAGE: INVESTIGATION OF THEIR CONTRIBUTION TO THE EUTROPHICATION PHENOMENON(ASPORTAZIONE DI FOSFORO E AZOTO CON LE ACQUE DI DEFLUSSO E DI DRENAGGIO SUPERFICIALI: INDAGINE SUL LORO CONTRIBUTO AL FENOMENO DELL'EUTROFIZZAZIONE).
Naples Univ. (Italy). Ist. di Chimica Agraria.
For primary bibliographic entry see Field 5B.
W91-12535

CHILDHOOD CANCER MORTALITY AND RADON CONCENTRATION IN DRINKING WATER IN NORTH CAROLINA.
National Inst. of Environmental Health Sciences, Research Triangle Park, NC. Epidemiology Branch.
G. W. Collman, D. P. Loomis, and D. P. Sandler.
British Journal of Cancer BJCAAI, Vol. 63, No. 4, p 626-629, April 1991. 2 tab, 39 ref.

Descriptors: *Cancer, *Carcinogenicity, *Drinking water, *Human diseases, *Mortality, *Public health, *Radon, *Water pollution effects, Epidemiology, Groundwater pollution, Mathematical studies, Statistical analysis.

The association between groundwater radon levels and childhood cancer mortality were explored in North Carolina. Using data from two state-wide surveys of public drinking water supplies, counties were ranked according to average groundwater radon concentrations. Age and sex-adjusted 1950-79 cancer death rates among children under age 15 were calculated for counties with high, medium and low radon levels. Overall cancer mortality was increased in counties with medium and high radon levels. The strongest association was for the leukemias. Relative risks were also increased for brain and central nervous system tumors, lymphomas, and bone cancer, but their precision was poor and dose-response gradients were not always present. These associations could be due to confounding or other biases, but the findings are consistent with other recent reports. (Author's abstract)
W91-12546

EFFECTS OF AROSURF MSF ON A VARIETY OF AQUATIC NONTARGET ORGANISMS IN THE LABORATORY.
Florida State Dept. of Health and Rehabilitative Services, Tallahassee.
P. G. Hester, M. A. Olson, and J. C. Dukes.
Journal of the American Mosquito Control Association JAMAET, Vol. 7, No. 1, p 48-51, March 1991. 2 tab, 11 ref.

Descriptors: *Arosurf MSF, *Insecticides, *Laboratory methods, *Mosquitoes, *Pesticides, *Toxicity, *Water pollution effects, Amphipods, Grass shrimp, Insect control, Isopods, Killifish.

Ninety-six-hour static acute toxicity tests were conducted in the laboratory to determine the effects of a 47 ml/sq-m (50 gal/acre) application of Arosurf MSF (2 mole ethoxylate of isostearyl alcohol) on Fundulus similus, Palaemonetes pugio, Palaemonetes paludosus, Uca species, Procambarus species, Gammarus species, Asellus species, Streptocephalus seali, Physa spp., Laeonereis culveri,. and an unidentified amphipod. Test temperatures of 20-27 C were based on the ambient water temperature for the season of the year when the desired life stages were more abundant. Test solutions and test organisms were placed in test chambers and kept there for the duration of the test. The criteria for determining acute effects in these organisms was lack of movement or reaction to gentle prodding. The maximum dosage tested (47 ml/sq-m) is 100 times the maximum Arosurf MSF label recommended application rate for mosquito con-

trol. No acute toxicity was observed with any of the organisms exposed to this concentration of Arosurf MSF. (Agostine-PTT)
W91-12549

EFFECT OF KELTHANE ON PH DEPENDENCY OF LIPASES IN TISSUES OF THE PENAEID PRAWN, METAPENAEUS MONOCEROS (FABRICUS) UNDER SUBLETHAL EXPOSURE.
Sri Venkateswara Univ., Tirupati (India). Dept. of Marine Zoology.
K. V. R. Rao, and P. Surendranath.
Pesticide Biochemistry and Physiology PCBPBS, Vol. 39, No. 3, p 205-209, 1991. 1 fig, 3 tab, 19 ref.

Descriptors: *Agricultural chemicals, *Hydrogen ion concentration, *Insecticides, *Kelthane, *Lipids, *Organochlorine pesticides, *Pesticide toxicity, *Shrimp, *Sublethal effects, *Toxicity, *Water pollution effects, Chronic toxicity, Fatty acids, Glycogen, Muscle, Tissue analysis.

Experiments were conducted to relate accumulation of the organochlorine insecticide kelthane in tissues with changes in the pH dependency of lipases in midgut gland and muscle of panaeid prawn from Buckingham canal in India. The pH-dependent lipase activity showed three peaks, an acidic (pH 4.0 to 4.5), a neutral (pH 7.0), and an alkaline (pH 8.0 to 8.5), in midgut gland and muscle tissues of the control and kelthane exposed prawn. In control prawns neutral lipase activity is high, while in kelthane-exposed prawns the acidic lipase activity is high in acute and chronic exposures. An increase in the three lipase activities was observed in kelthane exposure. A decrease in glycogen and total lipids and an increase in free fatty acids and glycerol were observed during kelthane exposure. The accumulation of kelthane residues was recorded in the midgut gland of chronically exposed prawns. The results confirm a prevalence of toxic stress. Some intracellular changes due to kelthane accumulation should be responsible for the activation of lipases. (Author's abstract)
W91-12553

OPERATIONAL WATER QUALITY MANAGEMENT: TRANSIENT EVENTS AND SEASONAL VARIABILITY.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-12599

DELAQUA--A PROTOTYPE EXPERT SYSTEM FOR OPERATIONAL CONTROL AND MANAGEMENT OF LAKE WATER QUALITY.
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
F. Recknagel, E. Beuschold, and U. Petersohn.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 283-290, 1991. 9 fig, 14 ref.

Descriptors: *Computer programs, *Data interpretation, *Data processing, *Databases, *Decision making, *Expert systems, *Lake restoration, *Water pollution control, *Water quality management, Aquatic environment, Artificial intelligence, Computer models, Computers, Data storage and retrieval, Ecosystems, Simulation analysis.

Aquatic ecosystems (open systems with a high degree of natural stochasticity) are living systems with high redundance in structure and behavior. Successful control of such systems demands a deep ecological understanding and sufficient experience in the practical handling of them. The expert system DELAQUA (Deep Expert System Lake Water Quality) has been developed as a decision aid in support of the management of water quality. DELAQUA accomplishes this task by combining artificial intelligence (AI) and simulation methods to facilitate ecological reasoning by models; there are brought together with heuristics for adequate ecosystem control by knowledge engineering. The system contains a knowledge base (PROLOG 2), a data base (dBASE III+), and a simulation system (FORTRAN 77), and is implemented on an IBM-PC with the MS-DOS operating system. Some potential uses of the expert system include: (1) deriving recommendations for operational control of undesired impacts on raw water quality by algal blooms or pathogens; (2) classifying raw water quality by legal standards; (3) predicting raw water quality under the changing control strategies and environmental conditions of lakes and reservoirs; and (4) the drawing of analogy conclusions with the use of measured and simulated water quality data from reference waters. (See also W91-12568) (Korn-PTT)
W91-12602

INTEGRATED MODEL EVALUATION SYSTEM (IMES): A DATABASE FOR EVALUATION OF EXPOSURE ASSESSMENT MODELS.
Versar, Inc., Columbia, MD.
For primary bibliographic entry see Field 7C.
W91-12606

EFFECT OF AQUATIC EXPOSURE AND DISINFECTION ON THE VIRULENCE OF ENTERIC PATHOGENS.
Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-195800. Price codes: A02 in paper copy, A01 in microfiche. Final Technical Report, 1991. 4p, 14 ref. USGS Contract No. 14-08-0001-G1493.

Descriptors: *Bacteria, *Bioindicators, *Disinfection, *Pathogens, *Water pollution effects, Image analysis techniques, Microbiology.

Studies were conducted to examine the persistence of enteric pathogens and their virulence-related properties with exposure to aquatic stress and disinfection. The initial effort was devoted to the adaptation of image analysis instrumentation in the rapid assessment of bacterial viability and injury in water using the direct viable count (DVC) technique. This analytical approach proved to be very useful in generating sufficient objective data for rigorous statistical analysis in a short time. Using this approach it was found that a range of enteric pathogenic and indicator bacteria each have different optima for both nalidixic acid and nutrients. This observation indicates that the common practice of using one level of these ingredients can lead to artifactual results. A series of experiments also examined the survival of enteric pathogens in water and their response to suboptimal disinfection. These results revealed that the pathogens have extended persistence in temperate, agricultural surface water and that experiments using enclosed vessels, 'microcosms', can lead to misleading results concerning both survival and extended pathogenic potential. Exposure to low concentrations of chlorine also led to injury and reduced virulence-related properties. (USGS)
W91-12627

PHOSPHATASE ACTIVITY IN SEDIMENTS OF THE LOOSDRECHT LAKES.
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2H.
W91-12664

SORPTION AND RELEASE OF PHOSPHORUS IN A PEATY SEDIMENT.
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2H.
W91-12665

ROLE OF DETRITUS IN THE PHOSPHORUS BALANCE OF LAKE LOOSDRECHT WATER.
Limnologisch Inst., Nieuwersluis (Netherlands). Vijverhof Lab.
For primary bibliographic entry see Field 2H.
W91-12666

DIATOM SEDIMENTATION LOSS REDUCTION BY RESUSPENSION IN SHALLOW LAKES.
For primary bibliographic entry see Field 2H.
W91-12667

AEROBIC DECOMPOSITION OF SETTLED ALGAE IN A LABORATORY SYSTEM: THE IMPACT OF RESUSPENSION ON MICROBIAL ACTIVITY.
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2H.
W91-12668

MODELLING BIOMASS AND OXYGEN DYNAMICS OF PROCHLOROTHRIX HOLLANDICA IN LABORATORY-SCALE ENCLOSURES.
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W91-12669

MODELLING THE EUTROPHICATION OF THE SHALLOW LOOSDRECHT LAKES.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 2H.
W91-12672

MANIPULATION OF THE THERMOCLINE IN A EUTROPHIC LAKE: THE RESPONSE OF THE ZOOPLANKTON.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W91-12678

SCALED CHRYSOPHYTES AS INDICATORS OF LAKE ACIDIFICATION IN WEST GERMANY.
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W91-12681

LONG TERM DEVELOPMENT OF PHYTOPLANKTON IN LAKE CONSTANCE.
Landesanstalt fuer Umweltschutz Baden-Wuerttemberg, Karlsruhe (Germany, F.R.). Inst. fuer Seenforschungs Fischereiwesen.
For primary bibliographic entry see Field 2H.
W91-12686

COMMUNITY GRAZING IN LAKES OF DIFFERENT TROPHIC STATES.
Munich Univ. (Germany, F.R.). Zoologisches Inst.
For primary bibliographic entry see Field 2H.
W91-12693

SPRING CLEAR-WATER PHASE IN A EUTROPHIC LAKE: CONTROL BY HERBIVOROUS ZOOPLANKTON ENHANCED BY GRAZING ON COMPONENTS OF THE MICROBIAL WEB.
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
For primary bibliographic entry see Field 2H.
W91-12697

COMPETITION EXPERIMENTS WITH TWO PLANKTIC BLUE-GREEN ALGAE (OSCILLATORIACEAE).
Humboldt-Univ. zu Berlin (German D.R.). Sektion Biologie.
For primary bibliographic entry see Field 2H.
W91-12699

ESTIMATION OF PHYTOPLANKTON PRODUCTION AND LOSS PROCESSES IN A EUTROPHIC SHALLOW LAKE.
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
H. Behrendt, and B. Nixdorf.
Internationale Vereinigung fuer Theoretische und

Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 893-896, March 1991. 2 fig, 19 ref.

Descriptors: *Eutrophic lakes, *Limnology, *Muggelsee, *Phytoplankton, *Population dynamics, Carbon cycle, Cyanophyta, Feeding rates, Food chains, Primary productivity, Water sampling, Zooplankton.

The phytoplankton balance processes in a eutrophic shallow lake (Lake Muggelsee) were estimated during the spring period 1986 and 1987 when a high grazing pressure was expected. At sampling intervals of 3 to 4 days, mixed samples of lake water were taken with a Friedringer sampler from 15 different horizontal and vertical points of the mixed layer. The specific grazing rate of phytoplankton caused by herbivorous mesozooplankton was measured from the differences of changing rates between phytoplankton subsamples with and without mesozooplankton which were exposed under the same conditions in the lake over two days. In Lake Muggelsee, diatoms possess a carbon content of about 6.5% of wet weight whereas the carbon content of blue-green and other algae was about twice as high with approximately 12%. Herbivorous zooplankton grazed 14% of primary production in 1986 and 20% in 1987. The mean net primary production (NP) rate was 31% and 29% of gross primary production (PP) rate, respectively. Dark carbon loss rates during the night were estimated in comparison to PP rate at 11% in both years. Losses were directly related to the primary production itself. The light losses are more than 80% of carbon-14 primary production in periods with dominance of blue-greens. The results strongly indicate the prime importance of physiological losses, especially in the light. The composition of phytoplankton has an important influence on these loss processes. Further investigations have to be directed to a more detailed measurement of single loss processes. (Brunone-PTT)
W91-12700

PHYTOPLANKTON OF EUTROPHIC LAKES IN WESTERN POLAND.
Institute of Physical Planning and Municipal Economy, Poznan (Poland).
R. Goldyn.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 905-908, March 1991. 1 fig, 2 tab, 19 ref.

Descriptors: *Cyanophyta, *Diatoms, *Eutrophic lakes, *Limnology, *Phytoplankton, *Poland, *Pollution index, *Species composition, *Species diversity, *Trophic level, *Water pollution effects, Abundance, Biomass, Epilimnion, Hypolimnion, Metalimnion, Municipal wastewater, Nonpoint pollution sources, Wastewater pollution.

The phytoplankton were quantified in twenty lakes in western Poland, from July 14 to August 26, 1982. The lakes differed with respect to size, depth, volume, catchment area, and degree of contamination with municipal sewage and nonpoint pollution load. Samples were taken from the epilimnion, the metalimnion, and the hypolimnion. The phytoplankton from most of the lakes was dominated by chlorococcal green algae. In some lakes, a great number of diatom taxa (Tuczno, Gorzynskie, Strzyminskie, Wielkie, Kolenski Lakes) or blue-green algae (Miejskie, Kuchenne, Kolenskie, Jaroszewskie Lakes) were observed. With an increase in trophy, the proportion of blue-green and/or chlorococcal algae in the abundance and biomass of phytoplankton also rises. The indices of the diversity and dominance calculated from abundance and biomass of organisms confirm that with increased trophy of lakes species diversity decreased. To calculate the summaric index, thirteen indices were used: abundance and biomass under 1 sq m, maximal abundance and biomass, proportion of blue-green algae in the total abundance and biomass, abundance and biomass of green algae, diversity and domination calculated from abundance and biomass of organisms, and saprobity. The summaric index facilitated much more precise evaluation of trophy of the investigated lakes than trophic state indices. Unfortunately, the summaric index used in the present form facilitates only comparison between the lakes, though after some modifications the summaric index may be transformed into a universal system. (Brunone-PTT)
W91-12703

EUTROPHICATION AND STRESS IN PHYSICALLY STABLE AND UNSTABLE LAKES: EFFECTS ON PHYTOPLANKTON STRUCTURE AND SEASONALITY.
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
W. Puchalski.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 909-912, March 1991. 6 fig, 13 ref.

Descriptors: *Algae, *Eutrophication, *Hypertrophic lakes, *Lakes, *Limnology, *Phytoplankton, *Seasonal variation, *Species composition, *Species diversity, *Strip mine lakes, *Water pollution effects, Abundance, Comparison studies, Epilimnion, Meromixis, Metalimnion, Nitrates, Poland, Population density, Thermal stratification, Turbidity.

The phytoplankton of stripmine lakes, formed in abandoned granite quarries in the region of Sudeten Foreland (southwest Poland) were analyzed. The physical and chemical parameters of strip mine lakes did not differ from those in temperate lakes, with exceptions of some cases of low mixing zone depth, meromixis or oligomixis and water contamination with high loads of nitrate or high turbidity. The specific phytoplankton composition frequently resembled those of subarctic shield lakes, with a high percentage of chrysophytes and low percentages of diatoms and blue-greens. In most hypertrophic lakes, the phytoplankton are distributed mainly in the metalimnion, with a yearly maximum in the spring. In stripmine lakes, phytoplankton are often concentrated in the epilimnion, due to depletion of nutrients in the hypolimnion and a steep thermocline. The distribution of phytoplankton abundance seems to depend on both physical stability and nutrient availability. Species diversity increased with increasing eutrophication, in contrast to typical hypertrophic lakes. (Brunone-PTT)
W91-12704

IN SITU AND IN VITRO CONSUMPTION OF TOTAL ORGANIC CARBON IN LAKE WATER AS DETERMINED BY MICROANALYSIS.
Istituto Italiano di Idrobiologia, Pallanza (Italy).
For primary bibliographic entry see Field 2H.
W91-12730

BREAKDOWN RATES OF ALDER (ALNUS GLUTINOSA) LEAVES IN AN ACID LAKE (LAKE ORTA, NORTH ITALY).
Istituto Italiano di Idrobiologia, Pallanza (Italy).
For primary bibliographic entry see Field 5G.
W91-12732

MASS BUDGET AS A TOOL FOR PREDICTING THE RESPONSE TO LIMING OF THE ACIDIFIED, AMMONIUM POLLUTED LAKE ORTA.
Istituto Italiano di Idrobiologia, Pallanza (Italy).
For primary bibliographic entry see Field 5G.
W91-12733

NITRATE REDUCTASE ACTIVITY IN FRESHWATER PHYTOPLANKTON.
Kinneret Limnological Lab., Tiberias (Israel).
For primary bibliographic entry see Field 2H.
W91-12737

CURRENT SITUATION AND CHANGING TENDENCY OF WATER POLLUTION IN MAIN LAKES OF CHINA.
Nanjing Inst. of Geography and Limnology (China).
Q. Tu, and P. Pu.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1081-1085, March 1991. 1 fig, 5 tab, 6 ref.

Descriptors: *China, *Lake classification, *Limnology, *Nutrient concentrations, *Water pollution effects, Chemical oxygen demand, Freshwater, Geographic distribution, Lake morphology, Mineralization, Water quality.

China has about 2300 lakes classified into eight categories (structural, crater, dam, glacial, karst, eolian, fluviatile, lagoon) and mainly distributed in five districts: the eastern plain lake district, the Qinghai-Xizang Plateau lake district, the Inner Mongolia-Xinjiang Plateau lake district, the Northeast Plain and mountain lake district, and the Yunnan-Guizhou Plateau lake district. The water capacity of these lakes is 707,700 cubic Mm, including freshwater of 225,000 cubic Mm. The distribution of lake water is very unbalanced in time and region; lakes in East Plain of the Changjiang River and the Huaihe River catchments are supplied by 500,000 to 600,000 cubic Mm per year; the annual supply of water to lakes is only 10,000 cubic Mm in Inner Mongolia and Xinjiang Plateau; lakes in Qingzang Plateau only about 1000 cubic Mm. The fresh lakes in the mid-lower Changjiang River have the lowest mineralization rate. Mineralization increases gradually from southeast to northwest with latitude. In the fresh lakes, bicarbonate is the dominant anion, constituting 70.5% of the total anions; calcium ions are the dominant cation, occupying the 41.5% of the total cations. At present, China's lakes are severely polluted by COD and nutrients. Thirty-five lakes are in the fourth to fifth degree of annual mean water quality, most of them are located near cities, and some are in scenic areas. By the end of the century, the lakes with water quality III will increase from the present 9 to 13 lakes, and the total lake area affected will rise to 3920 sq km (from 1297 sq km). In the 35 lakes surveyed, 10 lakes have a mean value of more than 6 mg/L COD, constituting 58.8% (17) of the polluted lakes. This percentage is predicted to rise to 77.5% by the end of the century. (Brunone-PTT)
W91-12740

CHAOHU LAKE EUTROPHICATION AND NUTRIENT LOAD REDUCTION.
Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.
C. Q. Yin, W. G. Jin, Z. W. Lan, and M. Zhao.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1086-1087, March 1991. 1 fig, 4 ref.

Descriptors: *Chaohu Lake, *Eutrophic lakes, *Eutrophication, *Lake restoration, *Limnology, *Nutrient concentrations, *Water pollution control, *Water pollution effects, Algal blooms, Channels, China, Drainage water, Drinking water, Ecosystems, Fertilizers, Irrigation, Particle size, Runoff, Seasonal distribution, Sedimentation, Soil erosion.

Chaohu Lake, located in East China, is an eutrophic lake that has frequent algal blooms, which cause serious problems in the regional development. Drinking water is often affected. The multi-pond system can reduce nutrient loads up to 90% from soil erosion and fertilizer loss. A small torrent, of 7.3 sq km area, was chosen to test the multi-pond system. The torrent had 104 ponds with different elevations. The runoff water with eroded material enters ponds in higher elevation. Water can be used by surrounding lands for irrigation, while drainage water flows back to the pond or to a pond of a lower elevation. Since rice needs frequent irrigation, water in the system is reused frequently before reaching the main river channel. In such a flow and cycling process, nutrients are retained through several mechanisms: (1) sedimentation of particulate nutrient in runoff and drainage water; (2) adsorption of dissolved nutrients by soil particle surfaces; (3) uptake by aquatic organisms and crops in spring and summer; and (4) reduction of nutrient loss by keeping water in terrestrial ecosystems. (Brunone-PTT)
W91-12741

SEASONAL AND VERTICAL OCCURRENCES OF PLANKTON FOR 5 YEARS IN A LAKE CIRCULATED BY POWER PLANT.
Nihon Univ., Tokyo. Biological Lab.
For primary bibliographic entry see Field 2H.
W91-12744

COMPOSITION, DISTRIBUTION AND ECOLOGICAL ROLE OF ZOOPLANKTON COMMUNITY IN LAKE VICTORIA, KENYA WATERS.
Nairobi Univ. (Kenya). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-12748

CYANOBACTERIAL NITROGEN FIXATION IN LAKE KARIBA, ZIMBABWE.
Zimbabwe Univ., Harare. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-12749

NUMBERS AND ACTIVITY OF BACTERIO- AND PHYTOPLANKTON IN CONTRASTING MARITIME ANTARCTIC LAKES.
British Antarctic Survey, Cambridge (England).
For primary bibliographic entry see Field 2H.
W91-12754

PHYTOPLANKTON STUDIES IN A TROPICAL LAKE (LAKE XOLOTLAN, NICARAGUA).
Centro para le Investigacion en Recursos Acuaticos de Nicaragua, Managua.
For primary bibliographic entry see Field 2H.
W91-12756

DYNAMICS OF PHOTOSYNTHETIC ACTIVITY IN LAKE XOLOTLAN (NICARAGUA).
Centro para le Investigacion en Recursos Acuaticos de Nicaragua, Managua.
For primary bibliographic entry see Field 2H.
W91-12757

ZOOPLANKTON STUDIES IN A TROPICAL LAKE (LAKE XOLOTLAN, NICARAGUA).
For primary bibliographic entry see Field 2H.
W91-12758

HETEROTROPHIC ACTIVITY AND BACTERIAL GROWTH IN A TROPICAL LAKE (LAKE XOLOTLAN, MANAGUA, NICARAGUA).
Centro para le Investigacion en Recursos Acuaticos de Nicaragua, Managua.
For primary bibliographic entry see Field 2H.
W91-12759

MERCURY CONTAMINATION IN LAKE XOLOTLAN (NICARAGUA).
Centro para le Investigacion en Recursos Acuaticos de Nicaragua, Managua.
For primary bibliographic entry see Field 5B.
W91-12760

PHOTOTROPHIC PIGMENTS AND MINERAL PHASES RECORDING EARLY ENVIRONMENTAL SIGNALS.
Heidelberg Univ. (Germany, F.R.). Inst. fuer Sedimentforschung.
For primary bibliographic entry see Field 2H.
W91-12773

DISCREPANCIES BETWEEN O2- AND 14C-METHOD RESULTING FROM MEASUREMENTS OF PRIMARY PRODUCTION UNDER CONSIDERATION OF VERTICAL MIXING IN A SHALLOW EUTROPHIC LAKE.
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
For primary bibliographic entry see Field 2H.
W91-12778

ANNUAL VARIATIONS OF THE PHYTOPLANKTON COMMUNITY DURING IMPOUNDMENT OF CANADIAN SUBARCTIC RESERVOIRS.
Montreal Univ. (Quebec). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-12781

PHOSPHORUS, CHLOROPHYLL AND THE COMPARATIVE LIMNOLOGY OF THREE SUBURBAN LAKES IN NORTHERN VIRGINIA, U.S.A.
North Carolina State Univ., Raleigh. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W91-12783

PHYTOPLANKTON INTERACTIONS BETWEEN TWO CONNECTED HIGHLY EUTROPHIC RESERVOIRS.
Gelsenwasser A.G., Gelsenkirchen (Germany, F.R.).
B. Westphal.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1313-1318, March 1991. 5 fig, 1 tab, 15 ref.

Descriptors: *Eutrophic lakes, *Eutrophication, *Limnology, *Phytoplankton, *Storage reservoirs, *Water pollution effects, Diatoms, Residence time, Spatial distribution, Species composition.

In the two storage reservoirs Haltern and Hullern, located in Germany, which are separated by a short distance of running water, the influence of Hullern, the upper reservoir, on the phytoplankton succession of Haltern was studied. The main residence time for Hullern is 21 days and for Haltern 24 days. The Stever River is the Nutrient-rich inflow to the Hullern Reservoir. After 1.4 km the outflow of the Hullern reaches the Haltern. The nutrient contents and water temperature of the Haltern Reservoir nearly correspond to those of the Hullern Reservoir, indicating that the chemical environment is very much influenced by the previous basin. However, the chlorophyll concentrations of the outflow of the Hullern Reservoir do not correspond with those of the second reservoir. While both basins have the same species composition, different taxa predominate at different times. The organisms of the Haltern reservoir resist immigrating species, because the available living space is always populated near optimum level. Thus, inflowing organisms cannot cause any change in the existing balance of Haltern Reservoir. (Brunone-PTT)
W91-12787

WATER QUALITY ASPECTS OF TWO SMALL SHALLOW MAN-MADE IMPOUNDMENTS WITH DIFFERENT WATER RESIDENCE TIMES.
Internationale Kommission zum Schutze des Rheins gege Verunreinigung, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W91-12788

PHYTOPLANKTON OF A LAKE AND A STORAGE SITUATED ON THE SAME RIVER RESERVOIR (LE PHYTOPLANCTON D'UN LAC ET D'UN RESERVOIR D'ACCUMULATION SITUES DANS LE COURS D'UNE MEME RIVIERE).
Institute of Physical Planning and Municipal Economy, Poznan (Poland).
E. Szelag-Wasielewska.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1340-1343, March 1991. 1 fig, 2 tab, 12 ref.

Descriptors: *Eutrophication, *Lake Strzeszynskie, *Limnology, *Phytoplankton, *Reservoirs, *Rusalka Reservoir, *Water pollution effects, Ammonia, Biomass, Chlorophyll a, Comparison studies, Conductivity, Dissolved oxygen, Hydrogen ion concentration, Nitrates, Nitrites, Orthophosphates, Species composition, Species diversity, Thermal stratification, Turbidity.

The Rusalka Reservoir is polymictic and incompletely thermally stratified, while Lake Strzeszynskie is dimictic, with complete thermal stratification. A number of physico-chemical factors, species composition, chlorophyll a, and phytoplankton biomass were sampled to evaluate the trophic status of the Rusalka Reservoir. Samples were taken from May 1978 to May 1979, for temperature, turbidity, water color, carbon dioxide levels, pH, dissolved oxygen, ammonia, nitrates. nitrites, orthophosphates, conductivity, chlorophyll a, and seston. Rusalka Reservoir has a greater number of species (256 taxa) than Lake Strzeszynskie (236 taxa), with chrysophytes, cryptophytes and chlorophytes dominant. The reservoir undergoes intense development of algal blooms. A positive correlation exists between the algal biomass and chlorophyll a, permitting the estimation of algal populations based on the chlorophyll a concentrations. The results suggest that correlations which are not actually important in Lake Strzeszynskie may play a role in the eutrophication of Rusalka Reservoir. (Brunone-PTT)
W91-12793

LIMNOLOGY OF LOWLAND SHALLOW IMPOUNDMENT NEAR WARSAW, POLAND.
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
For primary bibliographic entry see Field 5B.
W91-12794

DISTRIBUTIONAL PATTERNS OF PHYTOPLANKTON IN SPANISH RESERVOIRS: FIRST RESULTS AND COMPARISON AFTER FIFTEEN YEARS.
Barcelona Univ. (Spain). Dept. de Ecologia.
S. Sabater, and J. Nolla.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1371-1373, March 1991. 2 fig, 2 tab, 10 ref.

Descriptors: *Eutrophication, *Lake classification, *Limnology, *Phytoplankton, *Reservoirs, *Spain, *Species composition, *Water pollution effects, Eutrophic lakes, Mesotrophic lakes, Nutrient concentrations, Principal components analysis, Residence time, Statistical analysis, Stepwise discriminant analysis.

Broad-scale patterns of distribution of phytoplankton in Spanish reservoirs were compared with patterns observed in a similar study 15 yr. before. The composition and relative changes in time of phytoplankton assemblages may be considered as a response to environmental factors of the reservoir. One hundred reservoirs all over Spain were surveyed extensively between 1987 and 1988 in winter and summer, and phytoplankton samples were collected at 0, 2, 5, 10 and 20 m. Statistical treatment of the data included Principal Components Analysis, and Stepwise Discriminant Analysis. The same environmental factors (degree of eutrophy, total mineral content of the water) continue to affect the distribution of the phytoplankton in Spanish waters. The group of mesotrophic reservoirs has been greatly reduced. A high number of reservoirs in western Spain have increased numbers of eutrophic preferring phytoplankton taxa. These results indicate that, tentatively, Spanish reservoirs have become, on average, more eutrophic. However, a more detailed study which critically relates the phytoplankton distribution of the reservoirs with the nutrient content of the water, or with other factors such as residence time is required to obtain definitive conclusions. (Brunone-PTT)
W91-12801

DISTRIBUTION OF SEAGRASSES ALONG THE COAST OF TAMIL NADU, SOUTHERN INDIA.
Botanical Survey of India, Howrah (India).
For primary bibliographic entry see Field 2L.
W91-12802

EFFECT OF EXTERNAL PHOSPHORUS, NITROGEN AND CALCIUM ON GROWTH OF LEMNA TRISULCA.
Manitoba Univ., Winnipeg. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W91-12803

POLYCHLORINATED BIPHENYLS IN OYSTERCATCHERS (HAEMATOPUS OSTRALEGUS) FROM THE OOSTERSCHELDE (DUTCH DELTA AREA) AND THE WESTERN WADDEN SEA, THAT DIED FROM STARVATION DURING SEVERE WINTER WEATHER.
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 5B.
W91-12811

FORMATION AND EVOLUTION OF SOILS FROM AN ACIDIFIED WATERSHED: PLASTIC LAKE, ONTARIO, CANADA.
University of Western Ontario, London. Dept. of Geology.
D. E. Kirkwood, and H. W. Nesbitt.
Geochimica et Cosmochimica Acta GCACAK, Vol. 55, No. 5, p 1295-1308, May 1991. 6 fig, 8 tab, 46 ref.

Descriptors: *Acid rain effects, *Acidification, *Environmental chemistry, *Geochemistry, *Plastic Lake, *Weathering, Aluminum, Calcium, Dissolution, Feldspar, Leaching, Minerals, Ontario, Potassium, Soil profiles.

The Plastic Lake watershed contains podzols developed on glacial tills deposited 12,000 years ago. Present-day, cationic fluxes from the soils are greater by a factor of 2 than long-term fluxes averaged over the age of the tills. The high rates of present-day chemical weathering may be a result of increased input of anthropogenic acids into the Plastic Lake watershed. Time-averaged proportions of cations leached from the soils are strikingly different from the proportions of cations now being leached, indicating that the character of chemical weathering has changed over time. Weathering was and is dominated by mineral dissolution, but cation exchange has become increasingly important as the soils have matured. The large amount of Ca now released to the soil solutions probably is derived from exchange substrates, promoted by preferential uptake of Al onto the substrates. Aluminum is derived primarily through dissolution of feldspars. Bulk compositional analyses of soil profiles demonstrate that feldspars of the AE horizon release base cations (Na, K, Ca) and Al to solution in near-stoichiometric proportions, just as is observed experimentally for feldspar dissolution in acidic solutions. Surface area-normalized, time-averaged, dissolution rates of primary minerals of Plastic Lake soils are significantly greater than present-day rates measured for mature soil profiles. After just 12,000 years of weathering, biotite has been effectively exhausted in the Plastic Lake soils and much of the fine-grained feldspar probably has been dissolved. Time-averaged concentrations of elements removed from the soil, recast into essential mineralogy, indicate that vermiculite weathers most rapidly, followed closely by plagioclase. K-feldspar weathers less rapidly than plagioclase but more rapidly than quartz or hornblende. Al-silicate, possibly imogolite, and goethite are added to the soils during weathering. Plagioclase dissolution consumes more acid than all other reactions, accounting for 60% of the total acid consumed. Combined with K-feldspar, they account for > 80% of the total acid neutralized. The dissolution rate of quartz is one-half that of plagioclase; furthermore, the rate is consistent with the experimentally determined rates. (Lantz-PTT)
W91-12816

EFFECT OF PRUDHOE BAY CRUDE OIL ON THE HOMING OF COHO SALMON IN MARINE WATERS.
Washington Univ., Seattle. Fisheries Research Inst.
R. E. Nakatani, and A. E. Nevissi.
North American Journal of Fisheries Management NAJMDP, Vol. 11, No. 2, p 160-166, Spring 1991. 2 fig, 5 tab, 12 ref.

Descriptors: *Alaska, *Fish migration, *Oil pollution, *Oil spills, *Prudhoe Bay, *Salmon, *Water pollution effects, Marine environment, Oil industry.

Resource managers and the fishing industry have expressed concern that a crude-oil spill occurring in the pathway of a salmon run may destroy the ability of the maturing salmon to reach the home stream. To address this concern, groups of mature 3-year-old and precocious 2-year-old coho salmon Oncorhynchus kisutch were tagged and exposed in seawater for 1 hr to sublethal concentrations of Prudhoe Bay crude oil, dispersed oil, or seawater oil dispersant alone, and then were released in seawater about 5 km from their home stream. The results show that the coho salmon's homing success and speed of return to the home stream were not affected by any of the treatments. The longevity or holding tests, in which coho salmon were held in saltwater netpens after experimental treatments, showed that the larger 3-year-old coho salmon were more sensitive to the stress of confinement than the smaller 2-year-old fish. (Author's abstract)
W91-12829

EFFECTS OF NO. 20 FUEL OIL, PHENOL AND SODIUM SULPHIDE ON GROWTH, REPRODUCTION AND CHLOROPHYLL A CONTENT OF NITZSCHIA CLOSTERIUM (IN CHINESE).
East China Sea Fisheries Research Inst., Shanghai.
Y. Chen, and P. Rong.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 22, No. 1, p 21-28, January 1991. 2 fig, 8 tab, 16 ref. English summary.

Descriptors: *Diatoms, *Nitzschia, *Oil spills, *Phenols, *Phytoplankton, *Toxicity, *Water pollution effects, Bioassay, Chlorophyll a, Sulfides, Sulfur compounds.

The ship Sea Carrier (Panamanian) wrecked on May 11, 1984, near Nanji islands and polluted the area with No. 20 fuel oil, phenol and sodium sulfide. To assess the effects of this accident on phytoplankton, a series of bioassays was carried out with Nitzschia closterium by hemacymeter counting, as well as absorption and chlorophyll a detection. The results showed that the three chemicals had obvious effects on N. closterium. Both No. 20 fuel oil and phenol were toxic and phenol had the greatest effect. In the test period of six days, the maximum specific growth rate of N. closterium increased successively with the rise in concentration of sodium sulfide. The ranges of lowest-observed effective concentration (no-observed effective concentration of No. 20 fuel, phenol and sodium sulfide) affecting the growth of N. closterium were 32.0-3.2 mg/L for No. 20 fuel oil, 3.20-1.00 mg/L for phenol and .320-0.100 mg/L for sodium sulfide. For the chlorophyll a content the 216 hour-LC50 of phenol was 6.739 +/-0.003 mg/L. For cell division and reproduction the 144 hour-LC50 of No. 20 fuel oil was 46.13 +/-1.01 mg/L. No. 20 fuel oil in high concentrations inhibited the growth, reproduction and the chlorophyll a content of N. closterium. The oil in lower concentrations improved the growth and reproduction of the organism. (Author's abstract)
W91-12834

ANNUAL CYCLE AND SPATIAL HETEROGENEITY OF AUTOTROPHIC AND HETEROTROPHIC PROCESSES, AND PHYSICO-CHEMICAL FEATURES OF RIO TERCERO RESERVOIR, CORDOBA, ARGENTINA (CICLO ANUAL Y HETEROGENEIDAD ESPACIAL DE PROCESOS AUTOTROFICOS Y HETEROTROFICOS, Y CARACTERES FISICO-QUIMICOS DEL EMBALSE RIO TERCERO, CORDOBA, ARGENTINA).
Universidad Nacional de La Plata (Argentina). Inst. de Limnologia.
For primary bibliographic entry see Field 2H.
W91-12842

LETHAL AND SUB-LETHAL TOXICITY OF FIELD SIMULATED FARM WASTE EPISODES TO SEVERAL FRESHWATER INVERTEBRATE SPECIES.
University Coll., Cardiff (Wales). School of Pure and Applied Biology.
C. P. McCahon, M. J. Poulton, P. C. Thomas, Q. Xu, and D. Pascoe.
Water Research WATRAG, Vol. 25, No. 6, p 661-671, June 1991. 7 fig, 4 tab, 38 ref. NERC grant G.S.T. 02/201 Ane.

Descriptors: *Ammonia, *Dissolved oxygen, *Farm wastes, *Invertebrates, *Toxicity, *Water pollution effects, Amphipods, Hydrogen ion concentration, Parasites, Stream pollution, Wales.

Four field experiments designed to simulate the effects of the individual components of farm waste effluent (increased ammonia, reduced dissolved oxygen concentrations) on the invertebrate fauna of receiving waters were carried out on two second order streams in South Wales. In two studies the dissolved oxygen concentration was reduced to 2 and 1 mg/L by the oxidation of sodium sulfite, and in a further two studies ammonia concentrations were raised to 5 and 7 mg/L by dosing with ammonium chloride and the toxicant maintained in the unionized state by the simultaneous addition of sodium hydroxide to raise pH to approximately pH 9. During each simulation (6-24 hour in duration) the response of several invertebrate species placed in the downstream treatment zones was compared with that of animals maintained in an upstream untreated reference zone. Significant invertebrate mortalities were recorded only under conditions of reduced dissolved oxygen. The feeding rate of Gammarus pulex was significantly reduced during dosing with ammonia but recovered post-exposure. Parasitism of G. pulex with Pomphorhynchus laevis resulted in a reduced feeding rate and in increased mortality in comparison to uninfected animals. The disruption of precopula in G. pulex was a sensitive and rapid indicator of stress under both reduced dissolved oxygen and increased ammonia concentrations. (Author's abstract)
W91-12851

COMBINED EFFECTS OF METALS: AN ECOTOXICOLOGICAL EVALUATION.
Agricultural Univ., Wageningen (Netherlands). Dept. of Toxicology.
E. L. Enserink, J. L. Maas-Diepeveen, and C. J. Van Leeuwen.
Water Research WATRAG, Vol. 25, No. 6, p 679-687, June 1991. 3 fig, 9 tab, 32 ref.

Descriptors: *Ecotoxicology, *Metals, *Synergistic effects, *Toxicity, *Toxicology, *Water pollution effects, Arsenic, Cadmium, Chromium, Copper, Growth rates, Lead, Mercury, Nickel, Population dynamics, Survival, Water quality standards, Waterfleas, Zinc.

Additive joint actions of chemicals should be taken into consideration in the development of ecotoxicologically relevant water quality criteria. Existing criteria generally are derived for single chemicals, yet no natural waters exist in which only one compound is present. In order to determine the joint action of eight metals and to evaluate the Dutch water quality criteria for these metals, chronic toxicity tests were conducted with cohorts and populations of Daphnia magna. Four types of effects were distinguished: survival (LC50), body growth, intrinsic rate of natural population increase which were derived from individual daphnids, and maximum obtainable yield from experiments with populations. Arsenic, cadmium, chromium, copper, mercury, lead, nickel and zinc were tested singly and in equitoxic mixtures based on the LC50 (individual D. magna) or maximum obtainable yield (populations) of the individual metals. The expected toxicities of these mixtures were expressed as toxic units based on concentration addition. The LC50 was 1.8 toxic units and maximum obtainable yield of the mixtures was 1.6 toxic units, indicating an additive chronic toxicity of the metals with respect to individual survival as well as population growth of D. magna. Combined at

the maximum levels of the present Dutch water quality criteria these metals were severely toxic to D. magna and caused 50% mortality in Salmo gairdneri. S. gairdneri was exposed for 60 days during embryo-larval development. Even a reduction of these concentrations by a factor of five produced a 10% decrease of the yield of D. magna populations. (Author's abstract)
W91-12853

LONG-TERM PHENOMENOLOGICAL MODEL OF PHOSPHORUS AND OXYGEN FOR STRATIFIED LAKES.
Colorado Univ. at Boulder. Center for Advanced Decision Support for Water and Environmental Systems.
For primary bibliographic entry see Field 2H.
W91-12856

EFFECTS AND DEGRADATION OF 4-CHLORO-3-CRESOL IN A SYSTEM OF NATURAL SELF-PURIFICATION.
Landesanstalt fuer Umweltschutz Baden-Wuerttemberg, Karlsruhe (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-12857

REACTIONS OF AN EXPERIMENTAL OUTDOOR POND TO LINDANE APPLICATION.
Technische Univ. Muenchen, Freising (Germany, F.R.). Lehrstuhl fuer Botanik.
K. E. Neugebaur-Buchler, F. J. Zieris, and W. Huber.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 24, No. 2, p 81-92, April 1991. 13 fig, 31 ref. 'Umweltbundesamt (UBA)' of the Federal Republic of Germany Contract 12605001/01.

Descriptors: *Lindane, *Pesticides, *Ponds, *Water pollution effects, Algae, Aquatic animals, Aquatic plants, Artificial ponds, Crustaceans, Dissolved oxygen, Halogenated pesticides, Macrophytes, Pesticide residues, Waterfleas.

An experimental outdoor pond was examined for its reaction to the insecticide lindane. The pond was divided into three identical subunits: (1) the internal control; (2) application of 0.2 mg/L lindane over 8 weeks; and (3) application of 0.5 mg/L lindane over 8 weeks. Biotic and abiotic parameters of the three compartments were measured in the year of application and in the following year. At the end of the first year, no lindane residues were detected in the contaminated systems. The macrophytes showed no reaction to the insecticide. In the year of application, lindane caused an alteration in the algal composition, and the density of total phytoplankton increased in the compartments containing the pesticide. Copepods were damaged most by contamination with lindane, and several cladoceran species were also affected. In the post-application year, these effects were observed in the compartment that had been treated with 0.5 mg lindane/L. In addition, the dissolved oxygen content was reduced in this system. In the second year post-application, ostracods were sparse in the contaminated compartments. (Author's abstract)
W91-12866

URBAN RUNOFF EFFECTS ON OHIO RIVER WATER QUALITY.
Ohio River Valley Water Sanitation Commission, Cincinnati.
For primary bibliographic entry see Field 5B.
W91-12878

SYSTEMS APPROACH TO WASTEWATER PERSONNEL TRAINING.
Metcalf and Eddy International, Inc., Alexandria (Egypt).
J. L. Kules.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 73-75, June 1991. 5 fig.

Descriptors: *Education, *Management planning, *Personnel, *Systems analysis, *Training, *Wastewater facilities, Economic aspects, Project planning.

In 1987, Los Angeles, California committed itself to upgrading its wastewater personnel training. This resulted in a 3-year, multimillion dollar project to fully implement a training program that would significantly enhance the technical expertise of wastewater personnel and the facility's effluent quality. Systematically designed instruction focuses on advancing the performance learners must demonstrate using the components of the instructional design process. Los Angeles selected the Instructional System Design (ISD) which is a series of processes leading to the development of an effective training program. The ISD used by Los Angeles depicts the relationship between events. It is this relationship that makes the model so effective in its application to technical training development. It assures that the decision to develop training methods is based on identifiable needs of the employer, the learner, and the job. By setting measurable instructional objectives, the design and development of training related to specific wastewater personnel training needs are assured. Through the constant testing of materials, problems in the training program can be quickly identified and remedied. Thus, the ISD model is a cost-effective way to develop training. (Agostine-PTT)
W91-12884

MICROBIOLOGY AND CHEMISTRY OF ACID LAKES IN FLORIDA: I. EFFECTS OF DROUGHT AND POST-DROUGHT CONDITIONS.
Georgia Univ., Athens. Inst. of Ecology.
R. T. James.
Hydrobiologia HYDRB8, Vol. 213, No. 3, p 205-225, May 10, 1991. 4 fig, 7 tab, 53 ref, 2 append.

Descriptors: *Acid lakes, *Acid rain, *Drought, *Florida, *Limnology, *Microbiological studies, *Water pollution effects, Bacteria, Bacterial growth, Chlorophyll, Dissolved organic carbon, Ecosystems, Hydrogen ion concentration, Regression analysis, Statistical analysis, Water deficit.

Short-term changes in acid loading and dissolved organic carbon (DOC) content were studied in relation to water column bacteria of ten acid lakes on the Katherine Ordway Preserve, Florida. Five clear oligotrophic lakes and five dark dystrophic lakes were sampled during and after a drought period in July and September, 1985. Water column bacterial densities, light extinction, chlorophyll a, DOC, pH, dissolved oxygen, nutrients, and other chemical variables were measured. Significant positive correlations existed among DOC, chlorophyll a, pH, and water column bacterial densities during the drought period. There were no significant changes in water column bacterial densities or pH of clear lakes in the post-drought period, despite a 4.6-fold increase in acid loadings from rainfall. A 3-fold increase of DOC, a decline in pH, and decreased bacterial densities in dark lakes suggested inhibition of bacteria by DOC and pH. A decrease in the relationship of DOC to bacterial numbers in all lakes was also noted. The correlations among DOC, chlorophyll a, and pH were no longer significant. Using data from both time periods, significant polynomial regressions were observed between DOC and bacterial density, and DOC and chlorophyll a. Maximum bacterial numbers occurred at 20 mg C/L of DOC. Above this, bacterial numbers decreased also suggesting an inhibitory effect of DOC. Because pH was lower after DOC had increased in the dark lakes, the increase in acid conditions may have enhanced this inhibitory effect. The short-term effects of DOC on the dark-lake bacteria greatly exceeded the influence of acid loading on clear-lake bacteria. (See also W91-12889) (Author's abstract)
W91-12888

MICROBIOLOGY AND CHEMISTRY OF ACID LAKES IN FLORIDA: II. SEASONAL RELATIONSHIPS.
Georgia Univ., Athens. Inst. of Ecology.
R. T. James.
Hydrobiologia HYDRB8, Vol. 213, No. 3, p 227-240, May 10, 1991. 3 fig, 2 tab, 51 ref.

Descriptors: *Acid lakes, *Acid rain, *Drought, *Florida, *Limnology, *Microbiological studies, *Seasonal variation, *Water pollution effects, Bacteria, Bacterial growth, Biomass, Chlorophyll, Dissolved organic carbon, Ecosystems, Hydrogen ion concentration, Rainfall, Regression analysis, Statistical analysis, Water deficit.

To determine relationships of chemistry and microbiology in lakes exposed to acid precipitation, three clear and two dark acid lakes on the Katherine Ordway Preserve near Gainesville, Florida were monitored from February 1986 to July 1987. Chemical measurements included dissolved organic carbon (DOC), pH, acidity, temperature, dissolved oxygen, and nutrients. Bacterial densities, bacterial biomass, bacterial growth, bacterial assimilation of glucose, protozoan densities, and chlorophyll a were also measured. Rainfall and rainfall chemistry data were obtained from the Bradford Forest Acid Deposition station approximately 34 km NNW of the preserve. Although rainfall pH and clear-lake pH were similar, there were no relationships between H(+) deposition and clear-lake pH. There were no consistent or significant relationships between clear-lake pH and bacterial densities, bacterial biomass, chlorophyll a, or protozoan densities. Rainfall and acid deposition were both inversely related to glucose assimilation in surface water bacteria of clear lakes, indicating a stress of increased acid loading on the water column bacteria. Using both clear-lake and dark-lake measurements, a series of significant polynomial regressions between DOC and bacterial densities, bacterial biomass, bacterial growth, protozoan densities, and chlorophyll a were found. This suggested subsidy-stress relationships. As DOC increased to 20 mg C/L, the bacteria, protozoans, and chlorophyll a increased, a response to increased availability of substrate. Above 20 mg C/L as DOC increased the bacteria, protozoans, and chlorophyll a declined, a response to increased concentrations of toxic organic compounds such as phenols. (See also W91-12888) (Author's abstract)
W91-12889

5D. Waste Treatment Processes

DAIRY WASTEWATER TREATMENT USING ANAEROBIC FILTERS.
Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan, and S. R. Kikkeri.
Canadian Agricultural Engineering CAEOAI, Vol. 33, No. 1, p 143-149, January 1991. 3 fig, 5 tab, 20 ref.

Descriptors: *Anaerobic filters, *Anaerobic treatment, *Biological wastewater treatment, *Dairy industry, *Food-industry wastes, *Wastewater treatment, Biogas, Chemical oxygen demand, Retention time, Suspended solids.

The performances of three plastic medium upflow anaerobic filters operating at 12.5 C, 21 C, and 30 C in treating dairy wastewater were evaluated. COD removal efficiencies of all the reactors during start-up decreased by 20-25% when the reactor was subjected to a shock load which was 2.5 times the average strength with a pH of 5.8. All the reactors took approximately 10 weeks to recover to the earlier condition. When the reactors were subjected to an overload which was 1.5 times the average strength and the pH was 6.8 during start-up, COD removal efficiencies dropped by 6-8% in R1 and R2 (reactor start-up temperature at 21 C) and by 14% in R3 (reactor start-up temperature at 30 C). However, the reactors took approximately 10 weeks to recover to the earlier condition. COD removal during the start-up was 5-6% more at 30 C than at 21 C. The temperature (21 C vs 30 C) during start-up did not affect the subsequent steady-state performance. During steady-state operation, removal of COD in all the reactors decreased with a decrease in temperature and hydraulic retention time (HRT). Removals of suspended solids decreased with a decrease in temperature and HRT. Methane production depended both on temperature and HRT. Maximum gas production occurred at 30 C and 6 days HRT. Minimum gas production occurred at 12.5 C and 1 day HRT. The methane content in the biogas also depended on the temperature. The maximum meth-

ane content in the biogas was observed at the lowest temperature (80% methane at 12.5 C) and the minimum methane content at the highest temperature (68.4% at 30 C). Tracer studies showed that short circuiting occurred in all the reactors. The dead spaces were 22.2%, 22.2% and 17.6% for R1, R2, and R3 respectively. Solids accumulation analysis showed that in the reactor at 30 C, the volatile suspended solids (VSS) accumulation per unit weight of COD fed into the reactor was 0.0183 mg/mg, which was the least value compared to the solids accumulation rates in other reactors. The values for R1 and R2 were 0.04 mg/mg and 0.03 mg/mg respectively. VSS destruction was more at higher than at lower temperatures. The results indicate that anaerobic filter treatment of dairy wastewater at low temperatures is feasible; however, the treatment efficiency will be significantly lower. (Sand-PTT)
W91-11651

EFFECTS OF OXYGEN TRANSPORT LIMITATION ON NITRIFICATION IN THE ACTIVATED SLUDGE PROCESS.
California Univ., Los Angeles. Dept. of Civil Engineering.
M. K. Stenstrom, and S. S. Song.
Research Journal of the Water Pollution Control Federation RJWFE7, Vol. 63, No. 3, p 208-219, May/June 1991. 9 fig, 5 tab, 26 ref. NSF Grant CME-7911792.

Descriptors: *Activated sludge process, *Dissolved oxygen, *Model studies, *Nitrification, *Wastewater treatment, Ammonia, Carbon, Kinetics, Mass transport, Oxidation, Retention time, Shock loads.

A pseudohomogeneous model of the nitrifying activated sludge process was developed to investigate the effects of mass-transport resistance and heterotrophic/nitrifier competition on the apparent relationship between dissolved oxygen (DO) concentration and nitrification. The kinetics of both heterotrophic carbon oxidation and autotrophic ammonia oxidation within activated sludge flocs were described by an interactive-type, multiple-substrate-limiting model. The values for the model's parameters were estimated from a series of experiments that were conducted in laboratory-scale nitrifying activated sludge reactors. Using the estimated parameter values, the model was used to simulate the effect of organic shock loads and steady-state nitrification efficiency over a typical range of mean cell retention times (MCRTs), DO concentrations, and levels of mass-transport resistance. Varying oxygen transport effects, MCRTs, and heterotrophic/autotrophic competition for DO can combine to give apparent nitrification-limiting DO concentrations that range from 0.5 mg/L to as high as 4.0 mg/L. (Author's abstract)
W91-11757

DEPTH FILTRATION OF WASTEWATER: PARTICLE SIZE AND RIPENING.
Texas Univ. at Austin. Environmental and Water Resources Engineering Group.
J. L. Darby, D. F. Lawler, and T. P. Wilshusen.
Research Journal of the Water Pollution Control Federation RJWFE7, Vol. 63, No. 3, p 228-238, May/June 1991. 12 fig, 1 tab, 26 ref. USGS Grant No. 14-08-0001-G1502.

Descriptors: *Filtration, *Particle size, *Wastewater treatment, Flow rates, Head loss, Removal efficiency, Turbidity.

Laboratory-scale depth filtration experiments were conducted to investigate the effect of suspended particle size, flow rate, and media size on particle removal and head loss development during wastewater filtration. Particle size distributions were measured in detail on samples taken from various depths in the filter; pressure measurements were made continuously at the same locations. Particle size distribution measurements allowed a more detailed view of filter behavior than turbidity or suspended solids measurements. Ripening, that is, increased removal efficiency with time, occurred in all experiments but was significantly different for different-sized particles. The largest particles were effectively removed initially and improved in removal efficiency slightly. Intermediate-sized particles were not effectively removed initially but increased in removal efficiency rapidly and dramatically. The smallest particles measured were not effectively removed for a few hours, but then showed a significant increase in removal efficiency. Higher filtration velocity led to a small reduction in removal efficiency but a deeper penetration of the bed before particle removal, with consequent advantages in terms of head loss. (Author's abstract)
W91-11759

ASSESSMENT OF THE ROOT ZONE METHOD OF WASTEWATER TREATMENT.
Environmental Protection Agency, Boston, MA.
L. M. Conley, R. I. Dick, and L. W. Lion.
Research Journal of the Water Pollution Control Federation RJWFE7, Vol. 63, No. 3, p 239-247, May/June 1991. 4 fig, 3 tab, 32 ref.

Descriptors: *Artificial wetland treatment, *Biological wastewater treatment, *Macrophytes, *Secondary wastewater treatment, *Wastewater treatment, Biochemical oxygen demand, Design criteria, Kinetics, Wetlands.

The root zone method is a wastewater treatment technique consisting of a constructed wetland with subsurface flow of wastewater. The wetland, a lined basin containing media and wetland plants, treats wastewater by a variety of physical, chemical, and biological means. An evaluation of existing systems provides evidence that the root zone method can meet secondary treatment standards if properly designed and operated. The use of coarse media is recommended to avoid the common operational problem of overland flow. Additionally, the use of bulrushes as the wetland plant is recommended because their deep root zone reduces the surface area required for the root zone bed. Using data from existing systems, the value of the temperature-dependent rate constant for BOD removal (K20) was evaluated and found to be lower than the value implicit in a prevailing design equation. Design guidelines to determine required root zone bed volume and length and width configuration were developed assuming first-order kinetics, plug flow, and Darcy's law. In most cases, importation of granular material with adequate hydraulic conductivity may be necessary, and this requirement adds significantly to the cost of root zone treatment systems. Available performance data also indicate that a prevalent basis for root zone bed design overestimates performance. (Author's abstract)
W91-11760

BIOLOGICAL PHOSPHORUS REMOVAL IN A FED-BATCH REACTOR WITHOUT ANOXIC MIXING SEQUENCES.
Transenviro, Inc., Aliso Viejo, California.
M. C. Goronszy, and D. Rigel.
Research Journal of the Water Pollution Control Federation RJWFE7, Vol. 63, No. 3, p 248-258, May/June 1991. 15 fig, 4 tab, 25 ref.

Descriptors: *Activated sludge process, *Biological wastewater treatment, *Nutrient removal, *Wastewater reactors, *Wastewater treatment, Ammonia, Bulking, Nitrogen removal, Phosphorus removal.

A combined biological nitrogen and phosphorus removal using simplified fed-batch reactor methodology without formal anoxic mixing sequences was evaluated. Operational data from full-scale cyclic activated sludge systems show the effectiveness of using simple cycles of fill-react, fill-settle, and surface skim with coarse bubble aeration to achieve high levels of nitrogen and phosphorus removal from domestic wastewaters. An effluent quality of less than 10 mg/L biochemical oxygen demand, 10 mg/L total dissolved solids, 0.2 mg/L ammonia nitrogen, 5 mg/L total nitrogen, and 1 mg/L phosphorus with a nonbulking activated sludge having a sludge volume index of around 50 ml/g is obtainable under transient loading conditions. Interruption of fill during the surface skim sequence obviates the deleterious effects of short circuiting and bypass that otherwise occur in intermittent cycle activated sludge systems. (Author's abstract)
W91-11761

PERFORMANCE OF AN OVERLAND FLOW SYSTEM TREATING FOOD-PROCESSING WASTEWATER.
Bechtel Environmental, Inc., San Francisco, CA.
D. J. Tedaldi, and R. C. Loehr.
Research Journal of the Water Pollution Control Federation RJWFE7, Vol. 63, No. 3, p 266-275, May/June 1991. 8 fig, 11 tab, 14 ref. EPA contract 68-01-7266.

Descriptors: *Food-processing wastes, *Land treatment, *Overland flow treatment systems, *Wastewater treatment, Biochemical oxygen demand, Chemical oxygen demand, Surface runoff, Suspended solids.

In the overland flow (OLF) land treatment process, wastewater is applied to the top portion of graded, vegetated slopes. Treatment occurs as the applied wastewater interacts with soil, vegetation, and biological surfaces. The OLF process is used with soils that are relatively impermeable, which results in the major portion of the applied wastewater exiting the system in the form of surface runoff. The runoff is collected in ditches or channels at the bottom of the treatment slopes and is discharged to an adjacent surface water body. The performance of a full-scale operating OLF system treating food-processing wastewater was evaluated. Performance was evaluated in terms of removal efficiency and wastewater parameters. Detailed performance data were obtained over a 10-year period from the Campbell Soup (Texas), Inc. OLF system in Paris, Texas, which has been in operation for more than 25 years. Long-term performance data indicated that the OLF system consistently achieved a high degree of treatment and pollutant removal from a surface discharge standpoint. Removals of BOD5, COD, TOC, and TSS were >92% (mass basis) and >93% (concentration basis). Total nitrogen removals were between 84 and 89%. Effluent mass discharges have remained well within the regulatory limitations for suspended solids and BOD5 for the 25 years that the system has been in operation. (White-Reimer-PTT)
W91-11763

EFFECT OF PH ON FUNGAL GROWTH AND BULKING IN LABORATORY-ACTIVATED SLUDGES.
Nanjing Inst. of Environmental Science (China).
P. Hu, and P. F. Strom.
Research Journal of the Water Pollution Control Federation RJWFE7, Vol. 63, No. 3, p 276-277, May/June 1991. 3 fig, 7 ref.

Descriptors: *Activated sludge, *Sludge bulking, *Wastewater treatment, Bacteria, Fungi, Hydrogen ion concentration.

Recent work has indicated that there are numerous different bacterial filaments in activated sludge, thus there are several causes of filamentous bulking. However, extensive growth of fungal filaments has been observed infrequently in these studies despite previous reports of fungal bulking. Laboratory fill-and-draw activated sludge systems were started with mixed liquor from a domestic treatment plant and fed glucose mineral salts medium. Two units each were maintained at pHs of 4, 5, 6, and 7. Effluent biochemical oxygen demand, total organic carbon, and suspended solids quickly dropped to low levels in all units. The sludge volume index was low at all four pHs until day 30, then increased dramatically (bulking) for the units at pHs of 4 and 5. Fungal filaments were noted earlier at pHs of 4 and 5 and became abundant by day 30. At pHs of 6 and 7, fungal filaments remained at low concentrations. These results provide support for the hypothesis that fungi may be responsible for activated sludge bulking at low pH. (Author's abstract)
W91-11764

MATHEMATICAL MODELLING OF UPFLOW ANAEROBIC SLUDGE BED (USAB) SYSTEMS TREATING CARBOHYDRATE WASTE WATERS.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
S. S. Palns, M. C. Wentzel, P. L. Dold, R. E. Loewenthal, and G. R. Marais.
Water SA WASADV, Vol. 17, No. 2, p 91-106, April 1991. 6 fig, 4 tab, 30 ref, 2 append.

Descriptors: *Anaerobic digestion, *Mathematical models, *Model studies, *Sludge bed, Wastewater reactors, *Wastewater treatment, Acetates, Acetogens, Acidogens, Ammonia, Biofilms, Carbohydrates, Chemical oxygen demand, Hydrogen, Methane bacteria.

A mathematical model was developed that describes product formation and product utilization along the line of flow in a pelletized sludge bed of a single upflow anaerobic sludge bed reactor system with soluble carbohydrate as influent substrate. The model proposed 12 essential processes incorporating 16 essential compounds, and includes product (compound) utilization/formation by interaction between four groups of organisms: (1) acidogens; (2) acetogens; (3) acetoclastic methanogens; and (4) H2-utilizing methanogens. Product formation and utilization associated with the growth of these organism groups are modeled using Monod kinetics. The crucial effect of the hydrogen concentration, or equivalently the hydrogen partial pressure, on the growth/no growth of acetogens and the associated conversion/non-conversion of propionate to acetate are modeled using switching functions. The model assumes biofilm diffusion is negligible and that pH in the profile does not decline below 6.6. The model adequately predicts the concentration profiles of total soluble COD, acetate, propionate, organic nitrogen and free and saline ammonia in the pelletized bed under different chemical oxygen demand (COD) concentrations and influent flow rates with or without a recycle from the effluent to the influent, provided the substrate loading rate is below the maximum observed experimentally. (Author's abstract)
W91-11765

ORP AS A CONTROL PARAMETER IN A SINGLE SLUDGE BIOLOGICAL NITROGEN AND PHOSPHORUS REMOVAL ACTIVATED SLUDGE SYSTEM.
Ecole Nationale Superieure de Chimie de Rennes (France). Lab. de Chimie des Nuisances et Genie de l'Environnement.
M. de la Menardiere, J. Charpentier, A. Vachon, and G. Martin.
Water SA WASADV, Vol. 17, No. 2, p 123-132, April 1991. 7 fig, 10 tab, 14 ref.

Descriptors: *Nitrogen removal, *Nutrient removal, *Oxidation-reducion potential, *Phosphorus removal, *Tertiary wastewater treatment, *Wastewater treatment, Aerobic conditions, Anaerobic conditions, Biological wastewater treatment, France, Monitoring, Wastewater reactors.

A full scale study was conducted at the St. Mars la Jaille activated sludge system (Western France), which is one of the first successful biological excess phosphorus removal systems in Europe. The study was designed to demonstrate how the parameter oxidation reduction potential (ORP) can be used to optimize biological nitrogen and phosphorus removal in a two-series reactor system, by controlling air supply to the second aeration tank (for nitrification and denitrification) and monitoring anaerobiosis in the first non-aerated tank. It was found that setting ORP regulation limits in the aeration tank is of utmost importance in control of the system. High levels of carbon, nitrogen, and phosphorus removal were obtained for lower and upper ORP limits in the aeration tank of +200 and +400 mV respectively and +300 and +500 mV respectively (COD and SS removal > 95%; total kjeldahl nitrogen removal > 90% and P removal > 80%). In addition, ORP recordings enabled the aerobic, anoxic and anaerobic phases of a cycle in the aeration tank, and the degree of anaerobiosis in the non-aerated tank, to be monitored. (Author's abstract)
W91-11767

ELECTROLYTIC IRON FLOCCULANT PRODUCTION WITH A BIPOLAR ELECTRODE IN SERIES ARRANGEMENT.
Pretoria Univ. (South Africa). Dept. of Chemical Engineering.
W. A. Pretorius, W. G. Johannes, and G. G. Lempert.
Water SA WASADV, Vol. 17, No. 2, p 133-138, April 1991. 6 fig, 1 tab, 18 ref.

Descriptors: *Electrochemistry, *Flocculation, *Iron, *Wastewater treatment, Conductivity, Costs, Iron salts, Mathematical models, Phosphorus removal, Turbidity.

A non-conventional process for the production of metal cations suitable for the precipitation of phosphorus and the clarification of turbid water could be the electrochemical dissolution of metals directly in water. The use of electrochemical methods for flocculant production using iron is proposed. Although the mathematical modeling of the electrolytic process is complicated by the evolution of a hydrogen gas, relatively good correlations were found between experimental data obtained with bipolar electrodes in a cells in series arrangement and the simplified mathematical models. Correlation coefficients of R sq > 0.85 and a cell efficiency of 0.87 were obtained. These results indicate that once the effectivity of the electrolytic cell and the specific conductivity of the wastewater are known, the electrode sizes, spacings and numbers as well as the electric power required for a given iron dissolution rate could be calculated. At low current densities the cost of electrolytically produced iron flocculant compares favorably with commercially available iron salts. (White-Reimer-PTT)
W91-11768

SULPHATE, CALCIUM AND HEAVY METAL REMOVAL FROM INDUSTRIAL EFFLUENTS USING BARIUM CARBONATE.
Natal Univ., Durban (South Africa). Dept. of Chemical Engineering.
G. E. Trusler, R. I. Edwards, and C. A. Buckley.
Water SA WASADV, Vol. 17, No. 2, p 167-172, April 1991. 5 fig, 5 tab, 13 ref.

Descriptors: *Barium carbonate, *Calcium, *Heavy metals, *Industrial wastewater, *Sulfates, *Wastewater treatment, Acid mine drainage, Calcium sulfide, Cooling water, Effluents, Magnesium, Mine wastes, Sodium.

The potential for producing soluble calcium sulfide for use in treating heavy metal containing effluents was examined. Barium carbonate was reacted with calcium, magnesium, and sodium sulfate solutions containing industrial and mining effluents. All the feed solutions were reacted in a batch stirred reactor at ambient temperatures. Sulfates were effectively and quickly removed, especially if the sulfates were associated with calcium. If magnesium was present in the solution, the pH needed to be raised enough to allow magnesium to precipitate out as the hydroxide, to obtain effective sulfate and magnesium removal. Barium carbonate removed almost all zinc and cadmium ions from a zinc plant effluent and with effective lime pretreatment all sulfate. To obtain effective sulfate removal from a power station cooling water using barium carbonate, the addition of a mineral acid such as sulfuric acid was necessary. Calcium sulfide may be produced from by-products of the regeneration process, and sold for agricultural use or used to remove heavy metals from wastewater. (White-Reimer-PTT)
W91-11773

VINASSES BIOLOGICAL TREATMENT BY ANAEROBIC AND AEROBIC PROCESSES: LABORATORY AND PILOT-PLANT TESTS.
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Quimica.
C. D. de Bazua, M. A. Cabrero, and H. M. Poggi.
Bioresource Technology, Vol. 35, No. 1, p 877-93, 1991. 2 fig, 5 tab, 17 ref.

Descriptors: *Aerobic treatment, *Anaerobic digestion, *Biological wastewater treatment, *Vinasses, *Wastewater treatment, Biochemical oxygen demand, Biological treatment, Biomass, Chemical oxygen demand, Food-processing wastes, Performance evaluation.

Sugar cane is one of the main agricultural crops in Mexico. The main product is refined sugar with, as by-products, molasses and ethanol from molasses fermentation and distillation. In 1987, 1988, and 1989, Mexican alcohol production reached 115 million L, and 1500 million L of vinasses were generated. These vinasses were treated using an anaerobic fluidized-bed, pilot-plant scale, reactor (total volume, 300 L; bed working volume, 120 L), and two aerobic biodisc reactors of laboratory and pilot-plant scale (working volumes of 50 and 3,000 L). Vinasses fed to the reactors had chemical oxygen demand (COD) of 60 to 70 g/L, suspended solids of 11 g/L, a pH of 4.0-5.0, and a temperature of 20-25 C. For the anaerobic reactor, removal efficiencies were between 60 and 70%, measured as total COD, with loading rates as high as 20 kg COD/cu m fluidized bed volume/day, and hydraulic residence times as low as 2 days in the mesophilic range. Biogas productivity reached 6 cu m (STP)/cu m fluidized bed/day with a methane content of 70-85%. For the aerobic reactors, a 2-day retention time was fixed. At the laboratory scale, diluted vinasses were continuously fed into the system (approximately 5 gm COD/L), obtaining a microbial biomass that contained between 18 and 20% crude protein, with a yield of 1.8 kg wet biomass/kg of COD removed, a depuration efficiency of 65-70% COD, and a 95% biochemical oxygen demand (BOD). For the pilot plant scale reactor, undiluted vinasses were continuously fed (60-70 gm COD/L), obtaining the same biomass yield with a protein content of 20-30% and a removal efficiency of 40-50% of the total COD and 60-70% of the BOD. (Author's abstract)
W91-11778

ANAEROBIC DIGESTION OF RABBIT WASTES.
Escuela Univ. de Ingenierria Tecnica Agricola de La Laguna, Tenerife (Spain).
D. Trujillo, J. F. Perez, and F. J. Cebreros.
Bioresource Technology, Vol. 35, No. 1, p 95-98, 1991. 3 fig, 3 tab, 13 ref.

Descriptors: *Anaerobic digestion, *Farm wastes, *Rabbits, *Waste treatment, Animal wastes, Biogas, Biological treatment, Biological wastewater treatment, Hydraulic retention time, Methane, Volatile solids.

Recently, the treatment of animal wastes of high moisture content has led to energy production by anaerobic digestion. This process is also beginning to be recognized as a form of pollution control, which can be carried out in two ways: by discontinuous or continuous fermentation. Research was conducted using the anaerobic treatment of rabbit wastes to obtain a certain volume of combustible gas that could help solve the energy demands of a farm, and obtain an effluent with a lower pollution factor and a higher fertilizer value than fresh wastes. Three series of continuous experiments, differing in feedstock volatile solids (VS) concentration, were carried out. Earlier studies on a discontinuous process led to the choice of feedstock concentrations of 4, 5.5 and 7% VS. The hydraulic retention times (HRT) used were in the range of 35-5 days, decreasing gradually. These experiments confirm previous results and show that rabbit wastes can be anaerobically digested. The extent of digestion was relatively independent of HRT, so that a short HRT (about 15 days) could be used in practice; the volume of digester needed for a given volume of wastes would therefore be quite small. Although there was some decrease in methane percentage in the biogas with increased feed VS, the results show that gas of about 45-50% methane content was obtainable. However, gas with this methane content could cause combustion problems in boilers or engines. (Lantz-PTT)
W91-11779

COMPARATIVE ECONOMIC ANALYSIS: ANAEROBIC DIGESTER CASE STUDY.
North Carolina Dept. of Economic and Community Development, Raleigh. Energy Div.
P. D. Lusk.
Bioresource Technology, Vol. 36, No. 3, p 223-228, 1991. 5 fig, 1 tab, 8 ref.

Descriptors: *Anaerobic digestion, *Cost-benefit analysis, *Economic aspects, *Wastewater treatment, *Wastewater treatment facilities, Biological wastewater treatment, Comparison studies, Costs, Financial feasibility, Maintenance.

An economic guide was constructed to assess the value of anaerobic digesters. Two varieties of anaerobic digesters, a mixed-tank mesophilic and an earthen psychrophilic, were comparatively evaluated using a cost-effectiveness index. The two case study examples were also evaluated using three other investment merit statistics: payback period, net present value, and internal rate of return. Lifecycle savings were estimated for both varieties, with sensitivities considered for investment risk. It was concluded that an earthen psychrophilic digester can have an economic advantage over a mixed-tank mesophilic digester because of lower capital cost and reduced operation and maintenance expenses. (Author's abstract)
W91-11780

FIRST ORDER AND STEP-DIFFUSIONAL KINETIC MODELS IN SIMULATING THE MESOPHILIC ANAEROBIC DIGESTION OF COMPLEX SUBSTRATES.
Venice Univ. (Italy). Dept. of Environmental Science.
F. Cecchi, J. Mata-Alvarez, A. Marcomini, and P. Pavan.
Bioresource Technology, Vol. 36, No. 3, p 261-269, 1991. 4 fig, 6 tab, 19 ref. NATO Grant No. 0178/87.

Descriptors: *Anaerobic digestion, *Kinetics, *Model studies, *Wastewater treatment, Biological treatment, Biological wastewater treatment, Comparison studies, Mathematical models, Municipal wastes, Organic matter, Performance evaluation, Simulation analysis.

A kinetic analysis, using the step-diffusional and the first-order models, was carried out on: the product obtained from the anaerobic digestion of the organic fraction of municipal solid waste (OFMSW) sorted by plant at mesophilic conditions; the results of the anaerobic digestion of different mixtures of sewage sludge (SS); and, the OFMSW separately collected and also treated in mesophilic conditions. The step-diffusional model was tested to fit to different types of substrate, and yielded good results. This model is able to take into account substrate composition, which allows for a more general application of its constants. Thus, the kinetic constants obtained with different substrates (SS, mixtures of SS and the OFMSW separately collected, and OFMSW mechanically selected), are quite comparable. This is not the case, when a simple first-order kinetic model is applied. (Lantz-PTT)
W91-11781

BACTERIAL LEACHING OF HEAVY METALS FROM AEROBIC SLUDGE.
INRS-Eau, Sainte-Foy (Quebec).
D. Couillard, M. Chartier, and G. Mercier.
Bioresource Technology, Vol. 36, No. 3, p 293-302, 1991. 6 fig, 2 tab, 40 ref. Natural Sciences and Engineering Research Council of Canada Grant No. OGP0003711, and Ministere de l'Education of the Province of Quebec Grant FCAR EQ-3029.

Descriptors: *Aerobic treatment, *Biological wastewater treatment, *Heavy metals, *Leaching, *Wastewater treatment, Biological treatment, Chemical treatment, Copper, Hydrogen ion concentration, Oxidation-reduction reaction, Sludge digestion, Solubilization.

Fifty percent of sludges produced by wastewater treatment plants in the Province of Quebec (Canada) cannot be spread on agricultural land because of their heavy metal content. In batch experiments using an aerobic digested sludge, leaching of heavy metals by bacteria (Thiobacillus) was achieved. Different options were tested with reference to the time period required for metal solubilization and sludge digestion. Metal solubilization simultaneous with sludge digestion proved to be a process both slow and difficult to apply. In aerobic digested sludges, metal solubilization took place within one day at a rate of 7.7 mg Cu/L/d and at an initial concentration of 1022 mg/kg dry sludge. Oxidation-reduction potential (ORP) and pH were found to affect copper solubilization. The importance of the ORP in copper solubilization explains the great rapidity with which this element is made soluble in aerobic sludges; the high rates obtained in this study suggest that 1 day in a continuously-stirred tank reactor or 1 to 2 days in a batch reactor would suffice to achieve high solubilization efficiencies. (Author's abstract)
W91-11782

BANGKOK METROPOLITAN WASTE WATER AND REFUSE PROBLEMS.
Bangkok Metropolitan Administration (Thailand). Infrastructure and Environment Div.
For primary bibliographic entry see Field 5E.
W91-11802

ALTERNATIVE WASTE TREATMENT SYSTEMS.
Proceedings of the international conference held at Massey University, Palmerston North, New Zealand, May 26-27, 1988. Co-sponsored by the International Association of Water Pollution Research and Control, Massey University, and the New Zealand Government Department of Health. Elsevier Science Publishing Co., New York. 1988. 249p. Edited by Rao Bhamidimarri.

Descriptors: *Conferences, *New Zealand, *Waste management, *Waste treatment, *Wastewater management, *Wastewater treatment, Anaerobic digestion, Biomass, Composting, Productivity, Septic tanks, Soil treatment.

In recent years, the changing nature of the industrial and residential environment in some countries has revived the interest in low-cost on-site waste treatment while in others the search for alternative treatment systems is due to the fact that the conventional collection, treatment, and disposal techniques are either impractical or expensive. Based on the increased research effort into the low-cost on-site treatment systems in recent years, it was felt that the time was ripe for a specialized conference on the topic bringing together researchers and professionals actively engaged in this and related areas to exchange their knowledge and experience. The conference was cosponsored by the International Association on Water Pollution Research and Control, Massey University, and the Department of Health of the New Zealand Government. The proceedings of the conference are presented in a volume of six chapters. Chapters 1 to 5 contain papers which discuss specific technologies (septic tank systems, biomass production, soil and sub-soil treatment, composting technology, and anaerobic systems), while the contributions to the poster session form Chapter 6. The contributors to the conference are well-known researchers and professionals who bring the 'Appropriate Technology' concept to waste treatment and waste utilization. The case studies presented not only demonstrate the feasibility of alternative approach to waste treatment, but also point to the potential resource recovery. It is hoped that this volume will help initiate increased efforts into research and development of alternative waste management technologies. (See W91-11806 thru W91-11826) (Fish-PTT)
W91-11805

SEPTIC TANK SYSTEMS--STATE OF THE ART, 1988.
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
I. W. Gunn.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 2-13, 6 ref.

Descriptors: *New Zealand, *On-site wastewater treatment, *Septic tanks, *Wastewater treatment, Evapotranspiration, Infiltration, Rural areas, Septic wastewater, Trenches, Wastewater disposal.

Septic tank systems are widely used in rural-residential locations for on-site disposal of household and institutional wastewater, both in New Zealand and overseas. Design and installation practices have evolved from early empirical approaches in the U.S. to modern design guidelines based upon widespread research and performance studies undertaken from the mid-1960s to the mid-1980s. A better understanding of the mechanisms which contribute to good performance of soil infiltration and evapotranspiration in disposing of effluent has led to development of alternative on-site systems for meeting specific environmental and public health objectives in a range of climate and subsoil types. The use of soakage trenches and beds, evapotranspiration systems, mound and fill systems have proved adaptable for a variety of site specific requirements, and will ensure an important role for septic tank systems in servicing rural-residential development for the future. (See also W91-11805) (Author's abstract)
W91-11806

PASSIVE REMOVAL OF NITROGEN AND PHOSPHORUS USING AN ALTERNATIVE ON-SITE WASTEWATER SYSTEM.
Connecticut Univ., Storrs. Dept. of Civil Engineering.
R. Laak.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 14-21, 3 fig, 2 tab, 23 ref.

Descriptors: *Nutrient removal, *On-site wastewater treatment, *Septic tanks, *Wastewater treatment, Geotextiles, Infiltration, Nitrification, Nitrogen, Phosphorus, Sand filters, Septic wastewater, Soil filters.

The mechanisms for the removal of phosphorus and nitrogen in soils have been described, as have the effects of septic tank systems on the environment. It is clear that the conventional septic system provides insufficient treatment and utilizes available soil inefficiently. An underground on-site wastewater treatment (RUCK System) has been developed which uses a passive advanced treatment process and a compact soil field. Nitrogen is nitrified in an underdrained vented sand filter which removes excreted phosphorus. Laboratory studies show that anaerobic kitchen and laundry greywater serve as an organic carbon source for biological denitrification. A full-scale home-system field study showed that final effluent contains low concentrations of nutrients and solids. Phosphorus was completely removed in the sand filters and in 6 mm stone filters in acid conditions (pH 5). Nitrification reaction continued at low pH, at zero bicarbonate alkalinity and at field temperature of 10 C. Using anaerobic greywater as the electron donor, biological denitrification was achieved in fixed media, soil, and in bulk liquid. In-drains placed in soil infiltration surfaces yielded the same unit long-term acceptance rates for all vertical and horizontal infiltration surfaces. A redesigned infiltration soil surface using geotextiles permits up to four-fold smaller seepage fields. (See also W91-11805) (Fish-PTT)
W91-11807

DOMESTIC WASTEWATER MANAGEMENT ALTERNATIVES FOR THE MT LOFTY RANGES WATERSHED.
South Australian Dept. of Engineering and Water Supply, Adelaide.
P. M. Geary.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 22-32, 1 fig, 1 tab, 5 ref.

Descriptors: *Australia, *On-site wastewater treatment, *Septic tanks, *Wastewater management, *Wastewater treatment, *Watershed management,

Domestic wastes, Septic wastewater, Urban runoff, Urban watersheds.

Investigations in the Mt Lofty Ranges Watershed in South Australia have indicated that urban runoff and, in particular, effluent from failing septic tank systems, is contributing to nutrient related management problems in water supply reservoirs. Land capability investigations for subsurface effluent disposal within the watershed suggest that septic tank systems are unsuited to many areas. Alternative domestic wastewater treatment systems have been evaluated in the light of interstate and overseas experience as to their suitability for site conditions in the watershed. A number of alternative all-purpose systems (shallow placement, fill systems, alternating systems, mounded systems, aquaculture, evapotranspiration/absorption systems, sand filters, and aerobic treatment systems) and segregated/split systems (split systems, non-water carriage toilets, low water use toilets, and sullage waste removal) are recommended for further investigation. However, prior to their widespread introduction, existing institutional controls for the ongoing management and maintenance of both conventional and alternative wastewater treatment systems should be reviewed. (See also W91-11805) (Fish-PTT)
W91-11808

WASTEWATER TREATMENT USING AQUATIC PLANTS.
Sewage Treatment Planning Water Board, Sydney, N.S.W., 2000, Australia.
P. J. Fisher.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 34-44, 2 fig, 1 tab, 8 ref.

Descriptors: *Aquatic plants, *Australia, *Biomass, *Productivity, *Wastewater treatment, *Wetland treatment, Bioindicators, Biological oxygen demand, Bulrushes, Cattails, Nitrogen, Papua New Guinea, Suspended solids, Wetlands.

The potential of aquatic plants to treat wastewater has been demonstrated by the design, operation, and performance of seven large pilot scale constructed wetland systems receiving secondary treated effluent. The systems, constructed at Richmond, near Sydney, Australia, consisted of seven lined trenches containing various configurations of dense growths of Typha spp (cumbungi or cattail) and Schoenoplectus spp (bulrush) growing in gravel and open water stocked with Myriophyllum spp (parrot feather). In a two year study, effective removal of biological oxygen demand (95% maximum annual removal), suspended solids (94%) and total nitrogen (67%) was achieved by the systems when operating at hydraulic detention times of 2 to 10 days. Under these conditions, indicator bacteria were reduced by up to 5 orders of magnitude. The study indicated that aquatic plants offer a technically simple, low cost, energy efficient method of treating sewage. The application of this technology was demonstrated in an aid project in which an aquatic plant system was incorporated in sewage treatment facilities for a small village in Papua New Guinea. (See also W91-11805) (Author's abstract)
W91-11809

TRANSFORMATIONS OF NITROGEN IN A PINUS RADIATA FOREST SOIL FLOOD IRRIGATED WITH TREATED DOMESTIC EFFLUENT.
Lincoln Coll., Canterbury (New Zealand). Dept. of Biochemistry and Microbiology.
For primary bibliographic entry see Field 5C.
W91-11812

DESIGN CRITERIA FOR WASTEWATER INFILTRATION SYSTEMS.
Norges Landbrukshoegskole, Aas. Inst. for Georesources and Pollution Research.
P. D. Jenssen.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 93-107, 5 fig, 33 ref.

Descriptors: *Soil properties, *Soil treatment, *Wastewater disposal, *Wastewater treatment, Hydraulic conductivity, Hydraulic design, Infiltration, Load distribution, Soil classification.

Design of subsurface disposal systems for wastewater depends upon the hydraulic capacity of the soil deposit, purification ability of the soil and the wastewater's infiltration rate. In soils of low hydraulic conductivity the hydraulic capacity may determine the loading rate for wastewater. The purification ability of the soil is not easily assessed. Most design and sizing criteria are, therefore, based primarily upon hydraulic considerations. A diagram characterizing soils according to mean grain size and sorting (MESO-diagram) has been developed. The diagram is a basis for soil evaluation and system design. The subdivision of the diagram is based on soil's sedimentological and hydrogeological properties (e.g., genus, hydraulic capacity) combined with wastewater infiltration and purification properties. The diagram is used for site evaluation and to directly determine loading rates for wastewater and special design features. A maximum loading rate of 1.0 cm/d is proposed for soils with a hydraulic conductivity less than 3,000 cm/d. (See also W91-11805) (Author's abstract)
W91-11814

PROMISING TECHNOLOGIES FOR THE BIOLOGICAL DETOXIFICATION OF HAZARDOUS WASTE.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5G.
W91-11815

USE OF AEROBIC THERMOPHILIC COMPOSTING FOR THE STABILISATION OF PRIMARY MEAT WASTE SOLIDS.
Canterbury Frozen Meat Co. Ltd., Christchurch (New Zealand).
G. M. Keeley, and J. L. Skipper.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 120-131, 3 fig, 4 tab, 17 ref.

Descriptors: *Composting, *Meat processing industry, *Waste stabilization, *Waste treatment, *Waste utilization, Aerobic treatment, Compost marketing, Thermophilic bacteria, Waste management.

The wastes from a meat slaughtering complex processing lambs, cattle and pigs in New Zealand have traditionally undergone primary treatment consisting of screening, settling, and flotation. The solids removed by the primary processes were disposed of by land burial, but this is no longer environmentally or economically acceptable. Evaluation of solid waste treatment systems has indicated that thermophilic aerobic composting is the most appropriate treatment method. The process, based on the Beltsville static pile method, has proved simple to operate and control, does not involve high technology or high capital cost, and is environmentally acceptable. It has provided a means for resource recovery, with a finished product for which there is a defined market; technological control over basic microbial processes provides the means to convert the unstable and environmentally unacceptable waste into a mature stabilized compost. In considering facility design, process development, operating procedures, and end product use it has been necessary to evaluate raw material characteristics, maintain satisfactory aeration conditions and provide adequate disinfection and odor control. Overall process management and quality control testing is important to ensure a fully stabilized end product. (See also W91-11805) (Author's abstract)
W91-11816

DRYING OF SEWAGE SLUDGE BY AEROBIC SOLID STATE CULTIVATION.
Osaka City Univ. (Japan). Faculty of Science.
S. Oi, H. Yamada, H. Ohta, and H. Tanigawa.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 142-152, 5 fig, 3 tab, 8 ref.

Descriptors: *Sludge disposal, *Sludge drying, *Waste treatment, *Waste utilization, *Wastewater treatment, Digested sludge, Fertilizers, Japan, Land disposal, Lawns, Sewage sludge.

Wastewater sludge can be recycled as biomass for the double benefit of cleaning the environment and yielding economic benefits. Digested sludge produced from wastewater treatment plants in Osaka, Japan, was subjected to aerobic solid state cultivation to obtain fertilizer or an improver of farm soil. Both alkaline (pH 11.1) and acidic (pH 6.3) digested sludges, which were dewatered with slaked lime and ferric chloride or polyferric sulfide and peroxide of hydrogen, were employed. A seed culture was mixed with the equivalent of the same volume of the digested sludge, and then the mixture was placed in a series of culture boxes. The mixed sludge generated heat in a week and the temperature rose to 70-80 C. After one month of cultivation, the alkaline pH of the sludge dropped to pH 7.7, its water content decreased to 45.8%. Heat combustible values in the dried sludge were in the range of 1,550-2,030 kcal/kg, and corresponded to the 63% of the original digested sludge. When the dried sludge was distributed in a planting field of lawn grass, effective growth was attained with a sludge addition ratio of 20%. (See also W91-11805) (Author's abstract)
W91-11817

ON-SITE HYBRID ANAEROBIC TREATMENT OF PARTICULATED POULTRY WASTES.
Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
P. Y. Yang, and M. Chandrasekaran.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 154-165, 8 fig, 3 tab, 19 ref. USDA Special Grant: Tropical/Subtropical Agricultural Research, (87-CSR-2-3071).

Descriptors: *Anaerobic digestion, *Farm wastes, *Waste disposal, *Waste treatment, *Wastewater reactors, *Wastewater treatment, Baffles, Fertilizers, Manure, Mathematical models, Optimization, Poultry, Waste management.

Poultry manure is presently sold as fertilizer to plant growers. However, this is not satisfactory as the high moisture content adds to the cost of transportation and the foul odor makes handling and transportation difficult. Hybrid anaerobic treatment of particulated poultry wastes eliminates the problems commonly associated with conventional anaerobic treatment systems such as the preparation of a slurry prior to fermentation and the handling and disposal of post treatment effluent. The horizontally baffled reactor is simpler in both structure and operation in comparison to either the upflow anaerobic sludge blanket (UASB) reactor or the anaerobic filter, making it more suitable to treat wastes like manures on farms where technical manpower to operate complex reactors is not available. Laboratory studies of the system were performed where a horizontally baffled hybrid anaerobic treatment system was operated successfully to treat 5 batches of particulated poultry manure. It was found that, besides a steady operational performance, the hybrid system eliminates a number of problems associated with a conventional system, specifically that of handling and disposal of post treatment effluent. Other advantages include direct treatment of particulated manure and ease of operation. A mathematical model was developed for the optimization of the system, and was solved successfully by using a Continuous System Modeling Program. It was concluded that the design criteria of the horizontally baffled hybrid system is to have two reactors of equal volume. Operation of the horizontally baffled biogasification unit at a TCOD loading rate of 5.0 g/L/d with a 10-day manure detention time in the bioliquefaction unit further optimizes the system. This model cannot only predict the performance of the system but can also be used to outline the design and operational criteria for the optimal performance of the system. (See also W91-11805) (Fish-PTT)

W91-11818

BIOGAS RECOVERY FROM A THERMALLY TREATED SEWAGE SLUDGE BY A FIXED-BED ANAEROBIC BIOREACTOR.
Hiroshima Univ. (Japan). Faculty of Engineering.
N. Nishio, T. Kawasugi, and S. Nagai.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 166-171, 3 fig, 3 tab, 2 ref.

Descriptors: *Anaerobic digestion, *Biogas, *Sludge digestion, *Sludge treatment, *Waste treatment, *Wastewater treatment, Biodegradation, Biofilm reactors, Fermentation, Filtration, Liquid sludge, Methane, Sludge drying, Sludge excess, Solid waste disposal.

Anaerobic digestion (methane fermentation) has proved its worth as an effective means of removing pollutant organic materials from wastewaters and of achieving the useful by-product formation of methane. However, the long retention time and the low biodegradability of the sludge has prevented widespread use of anaerobic digestion in municipal waste treatment plants. It is possible that the thermal treatment of sludge using a fixed bed anaerobic bioreactor may improve biodegradability and enhance methane productivity. The excess sludge discharged from a municipal sewage sludge treatment plant was thermally treated at 175 C for 1 hr to reduce the filtration resistance of the sludge. This heat-treated sludge was dehydrated (up to 50% water content) and the dehydrated liquid (COD: 20,000 mg/L) was anaerobically fermented in a fixed-bed reactor at a COD loading of 7 kg/cu-m/day (HRT: 48 hr) with COD removal of 58.9%, and gas production of 1.8 cu-m/cu-m/day (CH4 content 72%). The removal efficiencies of organic materials in terms of COD and BOD were less than 90% (ranging between 60 and 80%), and discharging organic acids (consisting of acetic and propionic acids) seemed to be overproduced by acidogenesis, and these problems must be solved in the future. The proposed treatment system of sewage sludge, i.e., thermal treatment of the sludge, solid-liquid separation, use of the solid as a fuel source for thermal treatment and of the dehydrated liquid for methane fermentation, may be recommendable technology for the treatment of sewage sludge by an economical feasible means. (See also W91-11805) (Fish-PTT)
W91-11819

TEMPERATURE-CONTROLLED, AERATED STATIC-PILE COMPOSTING OF SLAUGHTERHOUSE WASTE SOLIDS.
Meat Industry Research Inst. of New Zealand, Hamilton.
A. J. van Oostrom, R. N. Cooper, and J. E. van Rossem.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 174-184, 4 fig, 3 tab, 7 ref.

Descriptors: *Aeration, *Composting, *Meat processing industry, *New Zealand, *Solid wastes, *Waste treatment, Bulking sludge, Compost marketing, Temperature control.

The New Zealand export meat industry produces large volumes of slaughterhouse solid waste, consisting mainly of paunch grass (ruminant stomach contents) and stockyard solids. Many advances have been made in materials handling and aeration of composting systems, of which the most notable is the Beltsville aerated-pile method. However, these advances have not included control over the compost temperature, and therefore do not overcome low decomposition rates and associated problems. The Beltsville aerated-pile method has been modified to include positive rather than negative pressure ventilation, and a high level of ecosystem management has been introduced by using feedback temperature control of the aeration system to remove excess heat (Rutgers Static Pile Composting Process). The Meat Industry Research Institute of New Zealand is investigating composting of slaughterhouse wastes with the objective of developing a compost that could be marketed as a complete plant potting mix without the requirement for nutrient addition. Experiments show that temperature-controlled aerated static-pile composting, using positive pressure ventilation, rapidly produces a stable, high-quality compost. Sawdust, granulated bark, and pumice sand are suitable bulking agents, and are required in small quantities, mainly to improve the structure of the finished compost for use as a potting mix. Because a bulking agent dilutes the nutrient value of the compost, its addition should be kept to a minimum (10-33% v/v) needed to ensure good product structure. The compost supports good plant growth and does not require nutrient amendment. (See also W91-11805) (Fish-PTT)
W91-11820

AQUEOUS WASTE SUBSTITUTION IN THE MANUFACTURE OF GIANT CEMENT AS A LOW-COST REUSE AND DISPOSAL OPTION.
M. B. Zanowick, J. W. Rainey, and R. J. Schoenberger.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 185-196, 2 fig, 3 tab.

Descriptors: *Cements, *Waste management, *Waste recovery, *Wastewater disposal, *Wastewater renovation, *Wastewater utilization, Liquid wastes, Slurries, Waste disposal, Waste treatment, Water reuse.

Wastewater reuse and waste disposal are the objectives of an aqueous water substitution project at Giant Cement Company in Harleyville, South Carolina. Giant operates four kilns for the production of cement clinker using the 'wet process.' In this process, all of the solid ingredients are pulverized and suspended in an aqueous slurry which is 30 to 50% water. This slurry enters the 'cold end' (400 F) of the kiln and is processed through the 'hot end' (2700 F) to produce cement clinker. Aqueous waste can be substituted for groundwater in the production of slurry. A percentage of the organic constituents of the waste stream are volatilized at the 'hot end' and thermally oxidized to stable end products. Metal and inorganic constituents are incorporated into cement clinkers. Giant Resource Recovery Company, Inc., a waste management entity, serves as the screening agent for waste streams, and manages the operations to assure that the final mixture of aqueous waste is compatible with cement production at Giant. The resultant waste substitution system represents an environmentally safe disposal option at lower costs than competing technology to the waste generator and lower cement production costs without the need to construct additional treatment facilities. (See also W91-11805) (Author's abstract)
W91-11821

EVAPO-TRANSPIRATION FOR ON-SITE RESIDENTIAL WASTEWATER DISPOSAL--THE NEW ZEALAND EXPERIENCE.
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
I. W. Gunn.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 197-208, 8 ref.

Descriptors: *Domestic wastes, *Evapotranspiration, *Land treatment, *New Zealand, *On-site wastewater treatment, *Septic tanks, *Wastewater disposal, *Wastewater treatment, Effluent seepage, Septic wastewater, Soaking, Trenches.

The use of engineered evapotranspiration seepage (ETS) beds for on-site household wastewater disposal was introduced to New Zealand in 1976 for locations unsuited to conventional septic tank soakage trench systems. The concept of an ETS system is to construct a shallow (300 mm) and narrow (1500 mm) sand bed over a layer of gravel (120 mm) in which a vented distribution pipe is laid. The top of the sand is mounded to the center to provide a sloping surface, then crowned with topsoil (100 mm) and planted with grass cover. Effluent from the household septic tank is preferably dose loaded into the bed system, in part then seeping into the subsoil, and in part being drawn up by capillary action in the sand to be taken up by plant transpiration and evaporated from leaf surfaces to the atmosphere. A temperate climate and long growing season favors the application of planted ETS beds in tight clay loam soils. Loading rates of 10 mm/day have proven satisfactory in such conditions; in some cases higher loading rates and poor siting practices have led to failures. Variations on ETS design include aerobic seepage beds (ASB), totally sealed beds with controlled overflow (TET), and partially sealed beds (PET). Case studies show that ETS system utilization in New Zealand is largely successful; the few unsuccessful beds were poorly sited and not protected from groundwater and/or surface water influences. Exposure to sun and wind, control of surface and subsurface drainage and use of long, narrow, and shallow bed systems planted in grass and dose loaded with well-settled septic tank effluent can achieve disposal in subsoil conditions which have a past history of problems for conventional septic tank soakage systems. (See also W91-11805) (Fish-PTT)
W91-11822

ALTERNATIVE METHOD FOR REDUCING NUMBERS OF FAECAL COLIFORM BACTERIA IN SLAUGHTERHOUSE EFFLUENT.
Lincoln Coll., Canterbury (New Zealand). Dept. of Biochemistry and Microbiology.
M. J. Noonan, H. Harman, and G. M. Keeley.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 219-229, 7 tab, 17 ref.

Descriptors: *Chemical treatment, *Fecal coliforms, *Hydrogen ion concentration, *Meat processing industry, *Wastewater treatment, Acidity, Alkalinity, Effluents, Farm wastes.

Some use has been made of extremes of pH in the past for the removal of disease-causing microorganisms from human and other wastes. Chemical treatment, relying on precipitation of proteins by a double pH adjustment and removal of suspended matter by dissolved-air flotation was designed for treating slaughterhouse effluent. Since the method only removes approximately 90% of the fecal coliforms, experiments were carried out to determine if more extreme pH levels and longer contact times would reduce fecal coliforms to lower levels. Samples of slaughterhouse effluent taken before treatment were adjusted to a pH more acid than used in the treatment, and others taken after acid treatment were adjusted to pH levels more alkaline than used in the treatment. Acid conditions down to a pH below 2 caused a decrease in numbers. Alkaline conditions of between pH 10 and 11 caused numbers to decrease. Larger reductions occurred with extremes of pH and longer contact times. (See also W91-11805) (Author's abstract)
W91-11824

TREATABILITY STUDY OF ORGANIC AND AMMONIA NITROGEN REMOVAL; SLUDGE SETTLING AND STABILISATION IN A ROTATING BIOLOGICAL CONTACTOR-SETTLING TANK SYSTEM.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
L. Teck-Suan, and K. H. Ahn.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 230-240, 14 fig, 4 tab, 9 ref.

Descriptors: *Ammonia removal, *Contactors, *Nitrogen removal, *Settling tanks, *Wastewater treatment, Biomass, Organic matter, Settleable solids, Sludge, Suspended solids.

Rotating biological contactors (RBC) were first commercialized in the 1960s in West Germany, and used successfully for treating both domestic and industrial organic wastewater. Many modifications of the RBC system have been reported, including many different integral RBC systems in use in Europe and the U.S. However, there has been no in-depth research cited in the literature for these integral RBC-Settling tank systems. An investigation was made into the removal of organic matter, ammonia nitrogen and suspended solids in

a compact RBC-Settling tank system. Different concentrations of synthetic wastewater were fed in parallel into 4-stage laboratory scale cascade-connected RBC-Settling tank reactors, at a fixed rotational speed and hydraulic loading. The results of the systems were expressed in terms of ammonia, organic and suspended solids loading and removal using the new concept of Disk Biomass Index (DBI) and Sludge Biomass Index (SBI). DBI and SBI were used to indicate the disk active biomass and sludge stability, respectively, with respect to organic loading and removal. The removal efficiency of suspended solids (SS), total dissolved organic carbon (TDOC), and soluble chemical oxygen demand (SCOD) were more than 95%. These results show an efficiency as high as those obtained with full scale operational integral RBC-Settling tank wastewater treatment plants. (See also W91-11805) (Author's abstract)
W91-11825

ALTERNATIVE WASTE TREATMENT SYSTEMS IN SOUTHERN NEW ZEALAND.
Christchurch Environmental Engineering Dept. (New Zealand).
K. P. McNeill, and J. W. Bradley.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 241-249.

Descriptors: *New Zealand, *Waste characteristics, *Wastewater treatment, Aerated lagoons, Contactors, Environmental control, Land disposal, On-site wastewater treatment, Oxidation ditches, Oxidation ponds, Sand filters, Urban planning.

Wastewater treatment systems must presently not only be cost-effective but must accommodate the particular physical site constraints, waste characteristics and environmental requirements of the project at hand. Areas in southern New Zealand present a unique challenge when considering the type and level of technology to be applied to the myriad of physical and environmental conditions encountered. The factors which place special financial and physical constraints on wastewater projects include: low overall population, low population density, seasonally fluctuating population, and pristine areas with a high demand for preservation of water quality. Cost-effective, easy-to-maintain systems, which provide a high level of treatment, are often necessary for environmentally sensitive and remote areas. Some alternative systems that may be considered are 'on-site' systems, small community sewerage systems, linking communities, intermittent biological sand filters (IBSF), oxidation ponds, aerated lagoons, rotating biological contactors (RBC), oxidation ditches, land treatment and disposal, and 'mix and match' systems. (See also W91-11805) (Fish-PTT)
W91-11826

MOLECULAR STRUCTURE BASIS FOR THE MUTAGENICITY OF LIGNIN- AND HUMIC-DERIVED CHLOROFURANONES.
State Univ. of New York, Syracuse. Coll. of Environmental Science and Forestry.
R. T. LaLonde.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-159442. Price codes: A04 in paper copy, A01 in microfiche. Final Technical Report, September 1990. 46p, 11 fig, 5 tab, 5 ref, append. USGS Contract No. 14-08-0001-G1498.

Descriptors: *Chlorination, *Chlorofuranones, *Disinfection, *Genotoxicity, *Halogenated organic compounds, *Molecular structure, *Mutagenicity, *Wastewater treatment, *Water chemistry, Ames test, Assay, Groundwater quality, Humic substances, Mutagens, Pollutant identification, Public health, Toxic substances.

The disinfection and industrial chlorination of humic-, and lignin-containing water produces nonvolatile genotoxins, the most potent among them being the direct acting mutagen MX (3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone, compound 1). Finding the essential features of MX structure that make this compound such a potent genotoxin was the goal of the project. Accordingly, the structure of MX was varied through the systematic replacement of the Cl atoms and the OH group by H. Thereafter, each compound was assayed in the Ames mutagenicity assay using Salmonella typhimurium (TA100). A total of ten 4-methyl-2(5H)-furanones and two 2(5H)-furanones were prepared and assayed. New methods were developed for preparing MX and members of the MX series that had not been prepared previously. Stability of the compounds under assay conditions was ascertained, and the pK sub a values for compounds possessing a C-3 OH group were determined. MX was the most mutagenic of the series. Its mutagenicity diminished by an order of 10 fold through replacement of C-5 OH or C-6 Cl by H. However the same replacements by H in a second compound (3-chloro-4(chloromethyl)-5-hydroxy-2(5H)-furanone, compound 2) resulted in the largest mutagenicity reductions of any in the entire series; these reductions amounted to 100 to 1000 fold. The C-3 Cl by H replacement amounted to a 100 fold reduction. These findings revealed that the minimum substitution required for potent mutagenicity is already incorporated in compound 2. The findings of this research will aid mutagenicity predictions for newly isolated, chlorine-substituted 4-methyl-2(5H)-furanones, and thereby, assist risk assessment of water remediation procedures involving chlorination. Taking a broader view, the findings suggest that for a series of closely related compounds, genotoxic potency does not abruptly change to nontoxicity. Instead genotoxicity diminishes gradually. (LaLonde-SUNY, College of Environ. Sci. and For.)
W91-11878

PERFORMANCE CHARACTERIZATION OF A MODEL BIOREACTOR FOR THE BIODEGRADATION OF TRICHLOROETHYLENE BY PSEUDOMONAS CEPACIA G4.
Environmental Research Lab., Gulf Breeze, FL.
B. R. Folsom, and P. J. Chapman.
Applied and Environmental Microbiology AEMIDF, Vol. 57, No. 6, p 1602-1608, June 1991. 5 fig, 3 tab, 22 ref.

Descriptors: *Biodegradation, *Biological wastewater treatment, *Pseudomonas, *Trichloroethylene, *Wastewater treatment, Bacteria, Biological treatment, Biomass, Microbial degradation, Model studies, Organic compounds, Phenols.

Pseudomonas cepacia G4 grown in chemostats with phenol demonstrated constant specific degradation rates for both phenol and trichloroethylene (TCE) over a range of dilution rates. Washout of cells from chemostats was evident at a dilution rate of 0.2/hr at 28 C. Increased phenol concentrations in the nutrient feed led to increased biomass production with constant specific degradation rates for both phenol and TCE. The addition of lactate to the phenol feed led to increased biomass production but lowered specific phenol and TCE degradation rates. The maximum potential for TCE degradation was about 1.1 gm/d/gm of cell protein. Cell growth and degradation kinetic parameters were used in the design of a recirculating bioreactor for TCE degradation. In this reactor, the total amount of TCE degraded increased as either reaction time or biomass was increased. TCE degradation was observed up to 300 microM TCE with no significant decreases in rates. On the average, this reactor was able to degrade 0.7 gm of TCE/d/gm of cell protein. These results demonstrate the feasibility of TCE bioremediation through the use of bioreactors. (Author's abstract)
W91-12011

EFFECT OF PROPIONATE TOXICITY ON METHANOGEN-ENRICHED SLUDGE, METHANOBREVIBACTER SMITHII, AND METHANOSPIRILLUM HUNGATII AT DIFFERENT PH VALUES.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
M. S. Barredo, and L. M. Evison.
Applied and Environmental Microbiology AEMIDF, Vol. 57, No. 6, p 1764-1769, June 1991. 4 fig, 33 ref.

Descriptors: *Hydrogen ion concentration, *Methane bacteria, *Propionate, *Sludge digestion, *Toxicity, *Wastewater treatment, Bacterial growth, Bacterial physiology, Biological wastewater treatment, Biomass, Methane.

Acetic, propionic, and butyric acids are the major volatile fatty acids present during anaerobic treatment of sludge. Although these volatile fatty acids are the main source of substrate for the methanogenic bacteria, some investigators have suggested that at high concentrations they are inhibitory for the methane-forming organisms. Methanobrevibacter smithii, and Methanospirillum hungatii were grown in Balch medium in Hungate tubes, and propionate toxicity was characterized by a decrease in production of methane and in bacterial numbers. Propionate inhibited bacterial growth and cumulative methane production at concentrations as low as 20 mM. In the absence of propionate, the methanogen-enriched sludge and M. smithii showed better cumulative methane production at pH 6.5 and 7.0 than at pH 8.0. However, in the presence of propionate, these organisms showed better cumulative methane production at pH 8.0. M. hungatii differed in its behavior; the best values of cumulative methane production for this organism occurred at pH 7.0. Bacterial numbers reflected the microbial response to the presence of propionate. The highest counts of methanogenic bacteria were observed at pH 6.5 and 8.0. The numbers of methanogens were affected by the presence of propionate even at concentrations as low as 20 or 30 mM; at propionate concentrations above 80 mM, the methanogen count was affected by at least 2 orders of magnitude. Upon comparison of the responses of the pure cultures and the methogen-enriched sludge to increasing propionate concentrations, it was found that the sensitivity of the pure cultures was similar to that of the methanogens in the sludge. (Author's abstract)
W91-12013

DIRECT DETERMINATION OF MOLECULAR HYDROGEN SULFIDE IN SEWAGE EFFLUENTS.
Ministry of Public Health, Safat (Kuwait).
S. A. Abdul-Wahab, A. A. Al-Haddad, and M. S. E. Abdo.
Journal of the Air & Waste Management Association JAWAEB, Vol. 40, No. 10, p 1410-1411, October 1990. 2 fig, 1 tab, 6 ref.

Descriptors: *Hydrogen sulfide, *Laboratory methods, *Wastewater treatment, Chemical analysis, Nitrogen, Pollutant identification, Wastewater.

In wastewater, dissolved sulfide is a mixture of molecular hydrogen sulfide (H2S) and hydrosulfide (HS(-)) existing in equilibrium with hydrogen ions. The proportions of H2S and HS(-) in this mixture are primarily a function of pH and pK. The standard analytical methods for sulfide determination in solution (e.g. Iodine method) permit measurement of total sulfide (H2S + HS(-)) rather than the direct measurement of H2S. Therefore, they suffer from being indirect and subject to interferences by other substances especially organic compounds. In this study, the direct determination of H2S in sewage samples was determined using a procedure which involves bubbling nitrogen through the aqueous sulfide solution to strip all the H2S which could escape to the gas phase, and measuring it by an H2S-gas detector. The amount of molecular H2S was then determined from the calculation of the total area under the curve relating the volume of nitrogen (L) and H2S concentration (mg/L) in the gas phase. Although at the beginning of the experiment, no H2S was detected, after several minutes, the gas started to appear, and the concentration of molecular H2S was seen to rise to reach a plateau, after which it came down. Moreover, the level of molecular H2S in the gas phase was higher with the higher initial concentration of H2S at 20 C. Because of the greater accuracy of the stripping method in determining the concentrations of molecular H2S, it was used to calculate Henry's constant for molecular H2S in distilled water and sewage samples utilizing different regimes of temperature and initial H2S concentrations. (Lantz-PTT)
W91-12038

POLYMER ADDITION AND STANDARDIZED PRACTICES IMPROVE TREATMENT PLANT EFFICIENCY.
R. LaBelle, and R. King.
Water Environment & Technology WAETEJ, Vol. 3, No. 5, p 8-9, May 1991.

Descriptors: *Odor control, *Operating policies, *Polymers, *Suspended solids, *Wastewater treatment, Clarification, Dewatering, Flocculation, Performance evaluation, Sludge thickening, Volatile solids.

Excessive accumulation of volatile solids in the primary clarifiers was causing chronic odor problems and low (33%) total suspended solids (TSS) removal at the New Bedford, Massachusetts, primary wastewater treatment facility. A study by Professional Services Group, Inc. found ineffective underflow pumping and insufficient capture in the sludge thickening and dewatering processes. Sludge-handling problems at the facility also included poor volatile solids capture. Reduced withdrawal created a high solids backlog in the primary clarifiers and carryover solids tended to settle and accumulate in chlorine contact basins, blocking chlorinated solution diffusers and inhibiting disinfectant dispersion. A pilot study was conducted in which dry polymer was fed to the plant's two gravity thickeners, and flocculation and volatile-solids capture improved substantially. A permanent polymer feed system was installed at the facility, and dry polymer is now systematically added to assist the thickening process when underflow from the clarifiers to the sludge thickeners drops below 2.5% TSS. Maximum sludge blanket limits of 0.46 m were established for the four 32-m-diameter clarifiers. Sludge blanket depths are now matched to sludge solids concentrations to achieve a mass balance. The operator can accurately determine the total volatile solids content of the sludge and calculate its fuel value to determine the amount of supplementary fuel needed to sustain combustion. The facility's raw wastewater pumps were also renovated to increase process efficiency and maintain a consistent flow of solids. The renovations at the plant have improved TSS removal from 33 to 56%. (Geiger-PTT)
W91-12073

NEXT GENERATION OF COMPUTERIZED PROCESS CONTROL.
Metcalf and Eddy, Inc., Laurel, MD.
J. F. Hale.
Water Environment & Technology WAETEJ, Vol. 3, No. 5, p 9-13, May 1991. 2 fig.

Descriptors: *Advanced wastewater treatment, *Cleanup operations, *Computers, *Expert systems, *Microcomputers, *Process control, *Wastewater treatment, Algorithms, Automation, Computer programs, Control systems, Decision making.

Expert systems software that assists the operator in making process control adjustments can be applied to process control for wastewater treatment, groundwater remediation, water resources and quality, advanced wastewater treatment, and other environmental treatment facilities. A microcomputer-based decision support system was implemented at a conventional activated sludge wastewater treatment facility to assist the operators in anticipating upset conditions and restabilizing the process if an upset occurs. The facility is located in an environment with constant high ambient temperature and high humidity which may affect biooxidation and other processes such as oxygen transfer. Variable loadings of organic and inorganic compounds and high chlorides periodically upset the plant process and cause effluent discharge violations. The plant-specific operating characteristics were derived from 9 months of controlled (stressed) operation of the facility under various operating modes, and the plant operations staff's experience. The dynamic control algorithms are then driven by current data results, trend analysis, current plant process and unit configuration, target variables, and the operator's subjective observations. The program generates daily summary reports that contain that day's data and suggested process control adjustments. Customized calculation formats are included within the database. Results are immediately available and updated on the computer's screen once pertinent input values are entered or changed. These formats, developed on a microcomputer, include process control calculations with a visual comparison against expected operating ranges. Installation of the decision support system has improved data management at the facility. Trend analysis allows process control calculations and determines solids wasting requirements even when no analytic data is available for that day. This has improved the plant's daily operation and lessened dependence on timely laboratory results to make process control decisions. (Geiger-PTT)
W91-12074

REDUCING NITROGEN IN REJECT WATER.
Watergroup A/S, Birkeroed (Denmark).
S. Dyhr-Jensen.
Water Environment & Technology WAETEJ, Vol. 3, No. 5, p 20, 24, May 1991.

Descriptors: *Ammonia, *Denmark, *Nitrogen removal, *Sludge drying, *Wastewater treatment, Dewatering, Lime, Physicochemical treatment, Separation techniques, Water pollution sources.

Recent work at wastewater treatment plants in Denmark shows that reject water (wastewater from sludge dewatering that is returned to the inlet of the plant) may be a major contributor of pollution to the plant that produced it. Two identical aeration tanks that receive equal volumes of wastewater from the same stream at the Saltebakken wastewater treatment plant differ in that one of the tanks also receives the reject water from the plant. The BOD in the tank loaded with reject water was over three times that of the other tank. The problem of pollutants in reject water can be solved by purifying the reject water before it is returned to the plant. A two stage physicochemical purification uses lime to raise the pH of the reject water to 11.5. At this high pH precipitation of the calcium phosphate and considerable quantities of suspended matter, BOD, heavy metals, and other materials occurs, while the ammonia is liberated as a gas by forced aeration. The blow-off of ammonia takes place in two stripping towers connected in series and filled with a plastic media of special design with a large surface. After this treatment, the purified reject water is returned to the inlet of the wastewater treatment plant. Initial results from the operation of this system at the Saltebakken wastewater treatment plant in Frederikshaven showed that the total discharge of nitrogen from Saltebakken has been reduced by about 150 kg/day, about 20% of the total plant production of nitrogen. The purification of reject water has improved operation of the Baltebakken plant by affording increased sight depth in the clarifier. The costs of the water reject treatment is usually about 3 to 5% of the total operational cost of the wastewater treatment plant. (Geiger-PTT)
W91-12075

BALANCING FLOW FOR CSO ABATEMENT.
New York City Dept. of Environmental Protection.
A. Forndran, R. Field, K. Dunkers, and D. Moran.
Water Environment & Technology WAETEJ, Vol. 3, No. 5, p 54-58, May 1991. 3 fig.

Descriptors: *Combined sewer overflows, *Detention reservoirs, *Flow balancing method, *Flow control, *Storm runoff, *Wastewater treatment, *Water pollution control, *Water quality control, Jamaica Bay, New York, Pontoons, Streams.

A flow balancing method (FBM) demonstration plant for the storage of combined sewage overflows (CSOs) for later water treatment was constructed on Fresh Creek, a tributary of Jamaica Bay, in Brooklyn, New York. The FBM facility was built of pontoons and curtains that formed a rectangular tank parallel to the shoreline. The CSOs had a lower density than the salt waters of the creek so that they filled up the tank from the top down forming a boundary layer between the CSO and the saltwater. A floating pump pumped back the CSO to the interceptor which automatically shuts off by means of a saline probe when the level of the salt water reaches the tank, thereby preparing the tank to receive the next CSO. A sludge dome was installed to retrieve deposited solids for the CSO and additional equipment was fabricated to handle floatables. Salinity profiles and flow measurement were monitored to indicate any overflow into the FBM. Concentrations for suspended solids in the FBM were less than 1000 mg/L and for BOD less than 100 mg/L. Total project costs were about $700,000. The FBM system operated successfully for 2 years under tidal ranges up to 2 m, winds gusting to 64 km/hr, and icing conditions. The floatables removal system should be improved and automated to reduce the labor required by manual raking and skimming. (Geiger-PTT)
W91-12079

ENVIRONMENTAL MEASURES IN SEWAGE WORKS.
Yokohama City Sewage Works Bureau (Japan).
For primary bibliographic entry see Field 5G.
W91-12080

FATE OF INDICATOR ORGANISMS IN SLUDGE DURING BACTERIAL LEACHING OF METALS.
Toronto Univ. (Ontario). Dept. of Civil Engineering.
J. G. Henry, D. Prasad, and W. B. Lohaza.
Canadian Journal of Civil Engineering CJCEB8, Vol. 18, No. 2, p 237-243, April 1991. 5 fig, 6 tab, 39 ref.

Descriptors: *Bacteria, *Bioindicators, *Heavy metals, *Land disposal, *Leaching, *Sludge disposal, *Sludge treatment, *Wastewater treatment, Biological wastewater treatment, Performance evaluation, Temperature, Thermophilic bacteria, Thiobacillus.

Biological extraction (bacterial leaching) of heavy metals from digested sewage sludge has been shown to be a practical means for decontaminating sludge for use on agricultural land. Research was conducted to assess the effect of bacterial leaching on various bacteria commonly used to indicate the possible presence of pathogenic organisms. The concentrations of four indicator bacteria (total heterotrophs, total coliforms, fecal coliforms, and fecal streptococci) were determined in a series of laboratory bacterial leaching units employing Thiobacillus ferroxidans. Although about 80-90% metal removal efficiencies were achieved (at a pH of 4.0 and an aeration of 100 mL/min of air per liter of sludge) at a temperature of 20-25 C, the indicator bacteria were not reduced during bacterial leaching at high suspended solids concentrations. The survival of indicator bacteria was a function of the suspended solids concentration in the leaching units, regardless of the source or type of indicator bacteria. At suspended solids concentrations greater than 10 g/L, the indicator bacteria were able to survive, apparently unaffected by the unfavorable environmental conditions (10 days retention at pH 4.0). Below this suspended solids concentration of 10 g/L, significant reductions of total coliforms, fecal coliforms, and fecal streptococci were achieved. Total heterotrophs did not follow the same trends as the other indicator bacteria. (Author's abstract)
W91-12084

DESIGNING WETLANDS FOR CONTROLLING COAL MINE DRAINAGE: AN ECOLOGIC-ECONOMIC MODELLING APPROACH.
Ohio State Univ., Columbus. School of Natural Resources.
For primary bibliographic entry see Field 5G.
W91-12112

REGULATION OF DISCHARGE OF ORGANOCHLORINES FROM PULP MILLS IN CANADA.
British Columbia Univ., Vancouver. Faculty of Law.
J. Hocking.

Environmental Management EMNGDC, Vol. 15, No. 2, p 195-204, March/April 1991. 18 ref.

Descriptors: *Bleaching wastes, *Canada, *Chlorinated hydrocarbons, *Dioxins, *Pulp wastes, *Regulations, *Wastewater treatment, Pulp and paper industry, Water pollution effects, Water pollution prevention, Water quality standards.

Organochlorines, formed as a byproduct of the chlorine bleaching process in pulp mills, have not been adequately regulated by provincial environmental protection legislation in Canada. Organochlorines such as dioxins and furans are, in varying degrees, toxic to humans and animals and should be regulated in pulp mill discharges. Dioxin and furan precursors are found in the oil base of washing additives and defoamers used to control the foaming that occurs when chemicals are washed out of the pulp. In the bleaching process, chlorine in water is used in a chemical reaction to remove the residual lining of the wood fibers. Any excess chlorine not used in the reaction with the lining may react with the dioxin and furan precursors to form the polychlorinated dioxins and furans. The formation of the polychlorinated dioxins and furans may be prevented or decreased by reducing and controlling the elemental chlorine used in the bleaching reactions. This is accomplished by using chlorine dioxide in place of chlorine or by using a process of oxygen bleaching known as oxygen delignification. Oxygen delignification has been extensively practiced in Sweden and Germany. New regulations suggested by the Ontario Ministry of the Environment dealing specifically with organochlorine discharges should be promulgated under the new Canadian Environmental Protection Act. The new regulations, which suggest an effluent allowance of 175 cu m of organochlorines/ton of pulp, should apply equally to all pulp mills and should be achieved by whatever method the individual pulp mills choose. Strict enforcement of the new standard, through cooperation of federal and provincial authorities is advised. (Geiger-PTT)
W91-12116

BIODEGRADATION OF CHLORINATED BIPHENYLS (FENCLOR 42) IN BATCH CULTURES WITH MIXED AND PURE AEROBIC CULTURES.
Bologna Univ. (Italy). Dept. of Applied Chemistry and Materials Science.
F. Fava, S. Zappoli, L. Marchetti, and L. Morselli.
Chemosphere CMSHAF, Vol. 22, No. 1/2, p 3-14, 1991. 4 fig, 3 tab, 21 ref.

Descriptors: *Aerobic bacteria, *Biodegradation, *Chlorinated aromatic compounds, *Fate of pollutants, *Polychlorinated biphenyls, *Pseudomonas, *Wastewater treatment, Chemical reactions, Culturing techniques, Microbial degradation, Molecular structure, Path of pollutants.

Many bacterial strains capable of degrading low chlorinated biphenyls have been found. However, to date, no culture capable of completely mineralizing more highly chlorinated biphenyls, or of growing on congeners having more than one chlorine has been unequivocally described. Two consortia of bacterial strains belonging to the genus Pseudomonas, and a pure strain of Pseudomonas cepacia were isolated from river sediments by using biphenyl and 4-chlorobiphenyl as a sole carbon source. Metabolic degradation of various polychlorinated biphenyls (PCBs) by these organisms was studied and the biodegradation products of 4-chlorobiphenyl in Pseudomonas were analyzed. Several low chlorine PCB congeners of the Fenclor 42 mixture (containing primarily tetra and penta chlorobiphenyls) were easily degraded by these mixed and pure cultures, especially in growing cell systems. Chlorine was not produced during the degradation of all the chlorobiphenyls tested, including 4-chlorobiphenyl. Results support other findings that: a decrease of degradation occurs as chlorine substitution increases; PCBs containing two chlorine atoms in the ortho positions of a single ring and/or in each ring show a strong resistance to degradation; PCBs containing all chlorine atoms on a single ring are generally degraded faster than those containing the same number of chlorine on both rings; and, preferential ring cleavage of molecules occurs at non-chlorinated or less chlorinated rings. (Author's abstract)
W91-12135

FATE OF WATER SOLUBLE AZO DYES IN THE ACTIVATED SLUDGE PROCESS.
Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab.
G. M. Shaul, T. J. Holdsworth, C. R. Dempsey, and K. A. Dostal.
Chemosphere CMSHAF, Vol. 22, No. 1/2, p 107-119, 1991. 1 fig, 6 tab, 11 ref.

Descriptors: *Activated sludge process, *Azo dyes, *Biodegradation, *Dye industry wastes, *Wastewater treatment, Activated sludge, Adsorption, Biological treatment, Biological wastewater treatment, Dyes, Liquid chromatography, Pollutant identification.

The objective of this study was to determine the partitioning of water soluble azo dyes in the activated sludge process (ASP). Azo dyes are of concern because some of the dyes, dye precursors, and/or their degradation products such as aromatic amines (which are also dye precursors) have been shown to be, or are suspected to be, carcinogenic. Specific azo dyes were spiked at 1 and 5 mg/L to pilot-scale treatment systems with both liquid and sludge samples collected. Dye samples included C.I. Acid Black 1, Blue 113, Orange (7, 8, and 10), Red (1, 14, 18, 88, 151, and 337), Yellow (17, 23, 49, and 151), and C.I. Direct Violet 9 and Direct Yellow (4 and 28). Samples were analyzed by high performance liquid chromatography (HPLC) with an ultraviolet-visible detector. Mass balance calculations were made to determine the amount of the dye compound in the waste activated sludge (WAS) and in the activated sludge effluent (ASE). Recovery for most dyes was within the targeted ranged of 80 to 120%, making it appeared that little or no chemical transformation occurred for these dyes because of contact with the variable wastewater and/or sludge matrix under these conditions. Of the 18 dyes studied, 11 compounds were found to pass through the ASP substantially untreated, and 4 were significantly adsorbed onto the WAS. C.I. Acid Orange 7, Acid Orange 8 and Acid Red 88 were apparently biodegraded. (Author's abstract)
W91-12142

EFFECT OF SELENIUM PRETREATMENT ON THE ACUTE TOXICITY OF MERCURY IN THE MUSSEL BRACHIDONTES VARIABILIS.
Middle East Technical Univ., Ankara (Turkey). Inst. of Marine Sciences.
M. Unsal.
Acta Adriatica AADRAY, Vol. 31, No. 1/2, p 163-171, 1990. 2 fig, 2 tab, 23 ref.

Descriptors: *Mercury, *Mussels, *Pretreatment of wastes, *Selenium, *Waste treatment, *Water pollution effects, Heavy metals, Lethal limit, Mortality, Toxicity.

Interactions of selenium with mercury were studied in the mussel Brachiodontes variailis, and 48-hr lethal concentrations (LC50) were determined for Hg in groups subjected to different Se pretreatments (250, 500, and 1000 microgm/L Se) 24 hrs before exposure to various concentrations of mercuric chloride. The LC50 value was also determined in a group exposed solely to Hg. Pretreatment with Se was found to significantly decrease Hg toxicity, and the degree of protection increased with increasing pretreatment concentrations. Treatment with Hg resulted in a 75% mortality in the group which did not receive Se as a pretreatment and was subjected to 250 microgm/L Hg. However, for the same concentration the mortality was 60, 10 and 0% in the groups pretreated with 250, 500, and 1000 microgm/L Se, respectively. (Lantz-PTT)
W91-12161

LINING UP IN SANTA BARBARA.
Santa Barbara City Public Works Dept., CA. Water Resources Div.
K. Goodenough, and D. Smith.
Public Works PUWOAH, Vol. 122, No. 4, p 74-75, April 1991.

Descriptors: *California, *Linings, *Rehabilitation, *Sewer systems, Cost analysis, Inversion lining, Manholes, Santa Barbara, Sliplining.

Systematic rehabilitation and reconstruction of 13 miles of deteriorated sewer lines in the Santa Barbara, California, 230 mile-long system is moving forward. Over 20,000 ft and 700 manholes had been completed by October 1990, with another phase of the program under way in 1991. The program is funded by additional revenue generated from a 30% increase in sewer rates enacted over a 2-yr period. About $100,000 is allocated annually to the manhole renovation program and $1 million to line replacement and rehabilitation. Measured in 1990 dollars, the Santa Barbara Public Works Department anticipates that the remaining 46,000 ft will cost $8 million to complete. A recently completed 2.5-mile segment provided the city's first experience with relining and an advanced method of renovating manholes. HDPE sliplining was conducted by a seven-member crew using video inspection. In other sections, the contractor had the option of using Insituform inversion lining or to replace existing pipe with PVC pipe. Manholes were rehabilitated using the IET System 3 method of resin mortar coating. Each method, replacement, inversion lining, and HDPE sliplining offers advantages depending on the work site. (Rochester-PTT)
W91-12210

CHARLOTTE MAPS NEW WASTEWATER STRATEGIES WITH GIS.
Camp, Dresser and McKee, Inc., Raleigh, NC.
S. W. Miles, C. R. Bristol, and A. L. Haynes.
Public Works PUWOAH, Vol. 122, No. 5, p 48-50, May 1991. 1 fig.

Descriptors: *Geographical information systems, *North Carolina, *Pipelines, *Sewer systems, Charlotte, Computer programs, Design criteria, Performance evaluation.

Tracking infiltration and inflow, combined with bypasses in large sewage collection systems, can be difficult. However, today's computer technology and state-of-the-art software can greatly aid the analysis process. The Charlotte-Mecklenberg Utility Department (CMUD, North Carolina) is currently developing strategies aimed at optimizing the operation of its wastewater system. Applying geographic information system (GIS) technology to this project has enabled CMUD to analyze a large proportion of its trunk system even while on a tight schedule. Two software packages were employed that run on an 80386 PC (IBM compatible): CDM:Sewer System Planner and CDM:Map Manager. The two packages were linked by the InfraWorks Network Information System. Geographic information was handled by the Arc/Info software running on engineering workstations. The GIS system has been used to create a hydraulic simulation model of the CMUD system. It demonstrated the effectiveness of flow equalization storage to reduce overflows and provided design information for conceptual designs of the proposed equalization facilities, including pump stations, pipelines, and storage basins. The GIS already provides returns beyond the aims of the study for which it was designed in the areas of planning and facilities mapping. (Rochester-PTT)
W91-12211

ULTIMATE BIODEGRADABILITY AND DECAY RATES OF COW PAUNCH MANURE UNDER ANAEROBIC CONDITIONS.
Bundesforschungsanstalt fuer Landwirtschaft, Brunswick (Germany, F.R.). Inst. fuer Technologie.
W. P. Tritt, and H. Kang.
Bioresource Technology, Vol. 36, No. 2, p 161-165, 1991. 1 fig, 4 tab, 7 ref.

Descriptors: *Anaerobic digestion, *Biodegradation, *Food-processing wastes, *Manure, *Waste treatment, *Wastewater treatment, Decay coeffi-

cient, Dry matter, Fatty acids, Incineration, Reaction rate, Statistical analysis, Volatile acids, Volatile solids.

Mesophilic batch tests of cow paunch manure were carried out to obtain the ultimate biodegradability and the first-order reaction rate. Each 5-liter batch reactor was operated for 49-63 days at various substrate to inoculum ratios, ranging from 0.2 to 10, without adding any chemicals. The primary technique used to determine substrate ultimate biodegradability was a graphic statistical analysis. The dry matter content was determined by drying (105 C) to constant weight. Total volatile solids were determined by incineration (550 C). The concentration of the volatile fatty acids were measured by gas-chromatography. Results showed that the ultimate biodegradability of 75-83% was obtained at most substrate to inoculum ratios. The first-order decay coefficient ranged from 0.044 to 0.064/day for reactors operated at a substrate to inoculum ratio up to 5.0. This reaction rate was faster than that found in plant biomass batch tests. Accordingly, an optimum ratio of cow paunch manure to inoculum of up to 2.5, was recommended for the fast start-up of a full-scale paunch manure anaerobic digester. (Mertz-PTT)
W91-12256

NUTRIENT REMOVAL AND ALGAL SUCCESSION DURING THE GROWTH OF SPIRULINA PLATENSIS AND SCENEDESMUS QUADRICAUDA ON SWINE WASTEWATER.
Novi Sad Univ. (Yugoslavia). Inst. of Biology.
M. Gantar, Z. Obreht, and B. Dalmacija.
Bioresource Technology, Vol. 36, No. 2, p 167-171, 1991. 2 fig, 1 tab, 22 ref.

Descriptors: *Biological wastewater treatment, *Chlorophyta, *Cyanophyta, *Farm wastes, *Wastewater treatment, Algae, Ammonia, Carbonates, Culturing techniques, Hogs, Manure, Nitrogen, Phosphates.

The efficiency of pig wastewater treatment by the green alga Scenedesmus quadricauda and bluegreen alga Spirulina platensis was investigated. Algal succession in batch cultures and their replacement by autochtonous algae was also studied. The liquid phase of swine waste was diluted to 10%, 20%, 30%, 40% and 50% of the original. In the case of S. plantensis, 1% of NaHCO3 was added to diluted waste: the undiluted wastewater contained 4745 mg/L total nitrogen, 4650 mg/L NH3-N, 17.0 mg/L P-PO4 and 2.1 g/L of total solids. Microscopic examination revealed the occurrence of algal succession in all cases. The abundance of the introduced alga depended upon time of cultivation and dilution of waste. At lower concentrations of waste, the nutrient uptake was efficient and the introduced algae were able to compete with autochtonous algae. At higher manure concentrations the efficiency of nutrient uptake was lower, and the introduced algae were outcompeted by autochtonous algae. At 50% dilution of swine waste, the introduced alga S. platensis was eliminated by the autochtonous algae by the 11th day of cultivation. Delayed replacement of cyanobacterium in comparison with the green alga, can be explained by addition of NaHCO3, which provided a substrate which was favorable only for the introduced alga. The dominant autochtonous alga was an unidentified unicellular alga resembling Chlorella. (Author's abstract)
W91-12257

EFFECTS OF AGITATION AND PRETREATMENT ON THE BATCH ANAEROBIC DIGESTION OF OLIVE MILL WASTEWATER.
Aix-Marseille-1 Univ. (France).
M. Hamdi.
Bioresource Technology, Vol. 36, No. 2, p 173-178, 1991. 4 fig, 2 tab, 24 ref.

Descriptors: *Anaerobic digestion, *Food-processing wastes, *Pretreatment of wastewater, *Wastewater treatment, Acidification, Biodegradation, Culturing techniques, Fermentation, Methane bacteria, Sludge treatment, Wastewater disposal.

The anaerobic digestion of olive mill wastewater can be carried out only on a diluted substrate because aromatic compounds and lipids are toxic for methanogenic bacteria. Sludge was obtained from an anaerobic contact digester, treating diluted olive mill wastewater at an average loading rate of 1 g/L/day. Substrate toxicity was based on the methane production at increasing concentrations of substrate. Gas samples were taken with a syringe from the headspace of the serum bottle and analyzed by gas chromatography. For the study of batch anaerobic digestion of unmodified and acidified olive mill wastewater, batch cultures containing proportions of olive mill wastewater ranging from 10-30 g chemical oxygen demand/L were used. In was shown that agitation decreased methane formation in anaerobic digestion of unmodified olive mill wastewater. Acidified olive mill wastewater was less toxic than was raw waste. Pretreatment of olive mill wastewater by fermentation with Aspergillus niger decreased the toxicity for methanogenic bacteria and facilitated anaerobic digestion. This showed that pretreatment with A. niger improved olive mill wastewater biodegradability and reduced its inhibition effect. It may be considered as a main step in the olive mill wastewater digestion. Agitation did not affect gas production. These results indicated that besides dilution, acidification or pretreatment can be a main means of carrying out the anaerobic digestion of olive mill wastewater with less inhibition of methanogenic bacteria. (Mertz-PTT)
W91-12258

ABWASSERREINIGUNG BIS ZUR REZYKLIERUNGSFAHIGKEIT DES WASSERS (WASTE WATER TREATMENT FOR RECYCLING QUALITY).
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Verfahrenstechnik.
H. Brauer.
Chemie-Ingenieur-Technik CITEAH, Vol. 63, No. 5, p 415-422, 425-427, May 1991. 16 fig, 23 ref. English summary.

Descriptors: *Industrial wastewater, *Industrial water, *Reclaimed water, *Wastewater treatment, *Water pollution prevention, *Water reuse, Environmental policy, Environmental protection, Environmental quality, Germany, Process control, Water conservation, Water pollution control, Water quality control.

Treatment of industrial wastewater is the most effective measure of protecting surface waters. This ecological aim is combined with the economic constraints of industry by designing the industrial process in such a way that production of harmful substances is reduced to an absolute minimum. Transfer of these pollutants into wastewater must be limited and volumetric flow of the water required for the overall process should be reduced to a minimum. Even when all these possibilities are successfully applied, a certain amount of harmful substances will remain in the effluent, causing environmental damage. In the end, long-term environmental protection can only be achieved by developing closed loops for the process water that include a wastewater treatment processes integrating mechanical, biological, and physico-chemical stages. (Mertz-PTT)
W91-12261

FOAM FLOTATION OF ZEOLITES: APPLICATION FOR ZINC ION REMOVAL.
Thessaloniki Univ., Salonika (Greece). Lab. of General and Inorganic Chemical Technology.
A. I. Zouboulis, D. Zamboulis, and K. A. Matis.
Separation Science and Technology SSTEDS, Vol. 26, No. 3, p 355-365, March 1991. 9 fig, 18 ref.

Descriptors: *Chemical treatment, *Flotation, *Foam flotation, *Ion exchange, *Separation techniques, *Wastewater treatment, *Zinc, Cation exchange, Foam separation, Industrial wastes, Metals, Surfactants, Zeolites.

Solid/liquid separation of a NaY zeolite, a known cation exchanger, was accomplished by foam flotation from aqueous suspensions. A cationic surfactant, at a concentration of 10 microM, was an effective flotation collector over a pH range of 5.5-9.5. The method was found to be applicable to a wide range of initial zeolite concentrations (up to 10 g/L), and was applied to the removal of zinc ions from aqueous solutions. Use of cetyl trimethylammonium bromide (water solution) or laurylamine (0.5% ethanol solution), and a 50% excess above the theoretical quantity of zeolite required for 100% removal of zinc ions, allowed effective removal of zinc ions over an initial concentration range of 0-200 ppm zinc. It was concluded that zeolite foam flotation from dilute aqueous dispersions may be a useful solid/liquid separation method. (MacKeen-PTT)
W91-12279

SELECTIVE REMOVAL OF CADMIUM FROM MIXED METAL SOLUTION BY CARBONATE INFUSION.
Ajou Univ., Suweon (Republic of Korea). Dept. of Environmental Engineering.
S. H. Cho, and Y. K. Kim.
Separation Science and Technology SSTEDS, Vol. 26, No. 3, p 381-394, March 1991. 7 fig, 5 tab, 17 ref.

Descriptors: *Cadmium, *Chemical precipitation, *Chemical treatment, *Heavy metals, *Metal-finishing wastes, *Separation techniques, *Wastewater treatment, Carbonates, Copper, Industrial wastes.

Carbonate infusion was used for the selective precipitation of cadmium from mixed metal solutions, such as synthetic wastewaters having initial concentrations of cadmium and copper ranging from 10-1000 microM. A comparison of copper carbonate precipitation with copper hydroxide clearly indicated the expected increase in solubility due to copper carbonate compounds. Maximum solubility of copper was observed at pH 9. The infusion of increasing concentrations of carbonate resulted in a decreased solubility of cadmium over the pH range of 8-10. The optimum conditions for selective precipitation of cadmium from mixed metal solution were as follows: pH 9; 100 microM Cu; 100 microM Cd; 0.5 M carbonate; 100 rpm mixing rate. Under optimal conditions, 97.7% of the copper is in the soluble portion and 98.7% of the cadmium is the in solid portion after 24 hr. Therefore, it was concluded that in the case of a cadmium and copper mixed solution, the selective precipitation of cadmium is possible. This method may be useful for the treatment of electroplating wastewater. (MacKeen-PTT)
W91-12280

FILAMENTOUS FUNGI AS METAL BIOSORBENTS: A REVIEW.
Hawaii Univ. at Manoa, Honolulu. Dept. of Botany.
S. M. Siegel, M. Galun, and B. Z. Siegel.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 335-344, October 1990. 3 fig, 1 tab, 29 ref.

Descriptors: *Biological wastewater treatment, *Filamentous fungi, *Fungi, *Heavy metals, *Literature review, *Wastewater treatment, Biological treatment, Biomass, Cadmium, Chromium, Copper, Hydrogen ion concentration, Iron, Lanthanum, Lead, Molybdenum, Nickel, Silver, Thorium, Uranium, Water pollution treatment, Zinc.

Common filamentous fungi (e.g. Penicillum spp., Rhizopus spp.) serve as sources of highly effective heavy metal biosorbents. Derivatives of fungal biomass range from purified cell wall fractions to whole, heat killed mycelium otherwise unmodified. Limited trials suggest a moderate degree of regenerability. When compared with commercial ion exchange resins, carbons and metal oxides, fungal derivatives generally perform well. Fungal systems offer considerable versatility with respect to metals taken up and bound including the cations Fe, Ni, Cu, Zn, Ag, Cd, La, Pb, Th, and U as well as Cr and Mo anions. Versatility also extends to physicochemical conditions, such as pH and heat tolerance. A deterrent to the application of these materials to wastewater management has been a lack of standardized conditions along with the inability to make interspecies comparisons. However, poten-

tials for use of filamentous fungi as biosorbents and their tailoring by genetic techniques to meet specific needs, recommend them for further research and development. (Author's abstract)
W91-12299

ANAEROBIC TREATMENT OF POTATO-PROCESSING WASTEWATER BY A USABR-UAF SYSTEM AT LOW ORGANIC LOADINGS.
Tianjin Univ. (China). Dept. of Civil Engineering.
J. Guo, and K. C. Lin.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 367-377, October 1990. 3 fig, 4 tab, 11 ref.

Descriptors: *Anaerobic treatment, *Food-processing wastes, *Potatoes, *Wastewater reactors, *Wastewater treatment, Chemical oxygen demand, Filtration, Food processing industry, Methane, Pollutant load.

Laboratory-scale models consisting of a simple upflow anaerobic sludge blanket reactor (UASBR) and an upflow anaerobic filter (UAF) in series were subjected to organic loadings of 0.19 to 0.55 kg COD/cu m/d at 20 C. Chemical oxygen demand (COD) and suspended solids (SS) removals were 95 to 98% and 98 to 99%, respectively. Biogas produced by the system amounted to 0.31 to 0.32 cu m CH4/kg COD removed. The UASBR was more stable than the UAF in performance. No sign of deterioration in final effluent quality was observed during 420 days of operation under low loading. (Author's abstract)
W91-12301

METAL CATION BINDING TO SPHAGNUM PEAT AND SAWDUST: RELATION TO WETLAND TREATMENT OF METAL-POLLUTED WATERS.
Villanova Univ., PA. Dept. of Biology.
R. K. Weider.
Water, Air and Soil Pollution WAPLAC, Vol. 53, No. 3/4, p 391-400, October 1990. 4 fig, 2 tab, 33 ref. EPA Grant R812379.

Descriptors: *Artificial wetlands, *Cations, *Metals, *Sphagnum, *Wastewater treatment, *Wetlands treatment, Chemical reactions, Organic matter, Sawdust, Wetlands.

Interest in the potential use of constructed and naturally-occurring wetland systems as a low-cost, low-maintenance method for the treatment of metal-polluted water has increased considerably in recent years. Because metal cation binding to organic matter represents one mechanism by which metals are retained in wetlands, laboratory studies were conducted of the binding of metal cations to Sphagnum peat and sawdust, two substrates used in wetland construction for the treatment of metal polluted waters. The two substrates differed in initial cation exchange characteristics, organic matter fractionation, affinities for ten different metal cations, and metal binding capacities. Results suggest a simple method for quantitatively assessing the potential for different types of organic substrates to retain metals by binding when exposed to metal-polluted water of a particular chemical composition. For metals that are retained in wetlands principally by binding to organic matter, application of the method could lead to an improved ability to formulate a priori cost-benefit analyses for contemplated wetland treatment of metal-polluted waters. (Author's abstract)
W91-12303

STUDIES IN BATCH AND CONTINUOUS SOLVENT SUBLATION. III. SOLUBILITY OF PENTACHLOROPHENOL IN ALCOHOL-WATER MIXTURES AND ITS EFFECTS ON SOLVENT SUBLATION.
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-12409

DISSIPATIVE STRUCTURES IN LIGAND-ACCELERATED METAL EXTRACTION SYSTEMS.
Illinois Inst. of Tech., Chicago. Dept. of Chemical Engineering.
C. Thomas, A. D. Nikolov, and D. T. Wasan.
Separation Science and Technology SSTEDS, Vol. 26, No. 4, p 539-557, April 1991. 13 fig, 18 ref.

Descriptors: *Chemical treatment, *Dissipation, *Metal complexes, *Wastewater treatment, Chemical properties, Chemical structure, Heavy metals, Metals, Molecular structure, Nickel, Turbulence.

Interfacial turbulence created by the addition of a ligand during the extraction of metal ions by an organic extraction can considerably enhance the speed of extraction. In the extraction of nickel with di-2-ethylhexyl phosphoric acid, interfacial turbulence in the oil phase was observed at the oil-water interface, accompanied by spontaneous emulsification, in the presence of acetate ligand. The dissipative structures were studied by Schlieren photography and found to consist of two distinct patterns of roll cells in addition to rapid twitching and fluctuation of the interface: (1) small roll cells originating at the interface, moving rapidly along the interface and dissipating at the interface; (2) large roll cells originating in the bulk aqueous phase, traveling toward the interface while gaining momentum, bouncing back from the interface, and dissipating as they receded. Both flow patterns were confined to the oil phase, the aqueous phase being virtually quiescent. The turbulence lasted for a minute, and rapid extraction of Ni ions was observed during this time period. The turbulence was completely damped out when surfactants were added to the system, and no turbulence was observed in the absence of ligand. The observations were interpreted in terms of interfacial instability theories, and are important for liquid membrane technologies because they suggest that systems with high extraction efficiencies can be engineered, even when the dispersed phase lifetimes are short. (Author's abstract)
W91-12410

REVERSE OSMOSIS APPLICATIONS IN SAUDI ARABIA.
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 3A.
W91-12457

EVALUATING THE PERFORMANCE OF TWO PLASTIC PACKINGS IN A CROSSFLOW AERATION TOWER.
California Univ., Berkeley.
For primary bibliographic entry see Field 5F.
W91-12459

BIOGAS PLANTS CONSTRUCTION TECHNOLOGY FOR RURAL AREAS.
Pakistan Council of Scientific and Industrial Research Labs., Lahore. Biotechnology and Food Research Centre.
M. Nazir.
Bioresource Technology, Vol. 35, No. 3, p 283-289, 1991. 10 fig, 18 ref.

Descriptors: *Anaerobic digestion, *Biogas, *Domestic wastes, *Energy sources, *Rural areas, *Wastewater treatment, Cold regions, Design standards, Digester design, Digester gas.

The suitability of a number of different anaerobic digester designs (biogas plants) was investigated over a period of two years for several experimental sites in rural Pakistan. The various types of biogas plants installed included: (1) a vertical biogas plant, (2) a horizontal biogas plant, (3) a community biogas plant, (4) a Chinese fixed-dome biogas plant, (5) a French-type biogas plant, (6) a rubber tubes biogas plant, and, (7) a polyethylene bag biogas plant. The results of the experiments revealed that biogas production in family-sized vertical biogas plants increased in summer and decreased in winter, proving to be unsuitable for cold areas. Heat losses were less in the community and horizontal biogas plants due to the water/oil jacket system. These innovations also reduced corrosion, avoided excessive dilution of slurry by rain water, made the plant more sanitary and reduced odor as compared with conventional Indian plants. A horizontal biogas plant was comparatively expensive but was suitable for those areas where the water table was high. Chinese biogas plants showed persistent leakage and seepage problems. Moreover, the gas pressure was low. French-type biogas plants worked efficiently in cold weather and are recommended for those areas where the atmospheric temperature drops below 0 C. Plastic and rubber bag biogas plants were cheap but deteriorated rapidly and could not be recommended. (Korn-PTT)
W91-12461

ENVIRONMENTAL CONSIDERATIONS FOR DESIGN OF THE ATHENS SEA OUTFALL, SARONIKOS GULF, GREECE.
Ministry of Environment, Planning and Public Works, 12 Varvaki Street, Athens (11474), Greece.
For primary bibliographic entry see Field 5E.
W91-12468

MANAGING SHRIMP POND WATER TO REDUCE DISCHARGE PROBLEMS.
Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W91-12493

CERIODAPHNIA BIOASSAYS OF CUYAHOGA RIVER SEDIMENTS, UPSTREAM AND DOWNSTREAM OF THE AKRON WATER POLLUTION CONTROL STATION.
Akron Univ., OH. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-12522

HEAVY METALS AND NUTRIENTS UPTAKE BY PLANTS AS AFFECTED BY THE APPLICATION OF ACID SLUDGE ON AN EGYPTIAN SANDY SOIL.
National Research Centre, Cairo (Egypt). Soils and Water Use Dept.
For primary bibliographic entry see Field 5E.
W91-12534

DESIGNING EXPERIMENTS FOR MODEL IDENTIFICATION OF THE NITRIFICATION PROCESS.
New Hampshire Univ., Durham. Dept. of Civil Engineering.
P. J. Ossenbruggen, H. Spanjers, H. Aspegren, and A. Klapwijk.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 9-16, 1991. 9 fig, 3 ref.

Descriptors: *Biodegradation, *Experimental design, *Model studies, *Model testing, *Nitrification, *Wastewater treatment, Activated sludge, Ammonia, Batch test, Calibrations, Data interpretation, Experimental data, Kinetics, Nitrogen, Oxygen uptake, Statistical analysis.

A total of four batch test experiments were performed to study the competition for oxygen by Nitrosomonas and Nitrobacter in the nitrification of ammonia in activated sludge. The data from these experiments were then used to propose and test different model structures describing oxygen uptake response and dynamic behavior, provide estimates of reaction rate parameters, and design a new set of experiments to affirm the test results. The oxygen uptake rate (OUR) and dynamic (compartment) models were described by a Monad relationship and the biodegradation process by a set of first order nonlinear differential equations with variable coefficients. Replications of the experiments are important when validating model structure because they permit additional lack of model fit tests to be performed and result in tighter inference intervals. The four batch test experiments were conducted under similar conditions giving a strong indication that the basic OUR model structure is valid. However, mass balance on total nitrogen revealed that the ammonium readings were not sufficiently accurate to permit model calibration and statistical assessment for three of the data sets.

An investigation of the stoichiometry of the nitrification process by coupling of the OUR and compartment models is recommended. In addition, numerical integration will be incorporated directly into a multi-response model parameter estimation procedure. Specially designed experiments, data from replicate experiments, and a more refined parameter estimate procedure will be used to critically evaluate the OUR and compartment models. These experiments and model identification procedures will lead to a better understanding of the nitrification process. (See also W91-12568) (Korn-PTT)
W91-12570

STOCHASTIC MODELING OF COMBINED SEWER FLOWS.
Nebraska Natural Resources Commission, Lincoln.
For primary bibliographic entry see Field 4C.
W91-12573

NON-LINEAR STOCHASTIC MODEL FOR ADSORPTION IN BATCH REACTORS.
Kansas State Univ., Manhattan. Dept. of Statistics.
J. Argyelan, A. P. Mathews, R. Nassar, and S. M. Lee.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 49-56, 1991. 3 fig, 1 tab, 11 ref.

Descriptors: *Activated carbon, *Adsorption, *Model studies, *Stochastic models, *Wastewater treatment, Adsorption kinetics, Batch treatment, Data interpretation, Isotherms, Simulation analysis, Sorption, Trichloroethylene.

Sorption processes are of fundamental importance in several environmental processes and in engineered systems to assure environmental quality control. A stochastic model was developed to represent single-component adsorption in batch systems with a Langmuir type, non-linear isotherm. A series of adsorption isotherm and rate experiments were conducted for the removal of trichloroethylene from water using activated carbon as the sorbent. The experimental data was then used to determine some of the parameters required for the simulation of batch and fixed bed adsorbers. The parameters estimated from the model were consistent with the physical phenomena, and could be used to model adsorption in fixed beds. Since the model equations were simpler to solve than deterministic model equations, the approach would be particularly valuable in the simulation of multicomponent adsorption. (See also W91-12568) (Korn-PTT)
W91-12575

DEVELOPMENT OF BEST OPTIMUM SOLUTIONS TO DRAINAGE PROBLEMS.
Dundee Coll. of Technology (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W91-12579

OPERATIONS AND CONTROL IN WASTEWATER TREATMENT--SOME SWEDISH EXPERIENCES.
Lund Univ. (Sweden). Dept. of Industrial Automation.
G. Olsson.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 193-200, 1991. 2 fig, 19 ref, append.

Descriptors: *Nutrients, *Sweden, *Wastewater facilities, *Wastewater treatment, *Water pollution control, *Water quality management, Biochemical oxygen demand, Data processing, Design criteria, Design standards, Management planning, Microbiological studies, Nitrogen, Operating policies, Phosphorus, Process control, Simulation analysis.

In order to reduce the discharge of nutrients, especially nitrogen and phosphorus, into the sea, the Swedish parliament passed legislation which states that nitrogen removal should be implemented and that biological oxygen demand (BOD) and phosphorus removal should be further increased at municipal wastewater treatment plants. The Swedish Board for Technical Development (STU) has initiated a special research program (STAMP) concerning the control of wastewater treatment systems, with the ultimate goal to find methodologies and operations that will guarantee high quality performance consistently under different external conditions. This has to be achieved by combining the use of methodologies in applied microbiology, environmental process engineering, automation, control, and working environment. Consequently, a multidisciplinary research team was created around the Lund Institute of Technology and the Malmo sewage works. Although problems most often are initiated by the plant, the different activities of the team are tied together to solve the various operational problems. In order to build a better knowledge base, a combination of laboratory and full-scale experiments will have to be conducted. The final products of these research efforts will include methods for characterization, and software tools for estimation, diagnosis, simulation, and control. (See also W91-12568) (Korn-PTT)
W91-12592

NETWORK ALGORITHM FOR THE OPTIMUM OPERATION OF URBAN DRAINAGE SYSTEMS.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5G.
W91-12594

DETENTION OF SANITARY SEWAGE AS A METHOD TO REDUCE COMBINED SEWER OVERFLOW POLLUTION LOADS.
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft.
For primary bibliographic entry see Field 5G.
W91-12595

OPTIMIZATION OF THE OPERATION OF THE OXIDATION DITCH PROCESS INCORPORATING A DYNAMIC MODEL.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. von Sperling, and J. P. Lumbers.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 225-233, 1991. 4 fig, 2 tab, 4 ref.

Descriptors: *Activated sludge, *Optimization, *Wastewater treatment, *Water quality management, Costs, Data interpretation, Monte Carlo method, Operating policies, Oxidation ditches, Simulation analysis, Statistical analysis.

A procedure for the optimal management of the oxidation ditch process was developed, which entailed the integration of a dynamic process model, an input forecaster, and an optimization algorithm. The system can be set to optimize operating costs (having the effluent quality as constraint) or process performance (having a maximum budget as a constraint). Simulations with data from full-scale oxidation ditches showed the usefulness of the method in terms of on-line control and/or off-line planning. A comparison between the proposed strategy and other conventional control policies was done by Monte Carlo simulation, varying the values of the inputs and initial states. Statistical analysis of the results indicated that, in general, the optimal management was able to give a significantly better effluent quality but, in some cases, at higher operating costs. (See also W91-12568) (Author's abstract)
W91-12596

STATE AND COEFFICIENTS ESTIMATION FOR THE ACTIVATED SLUDGE PROCESS USING A MODIFIED KALMAN FILTER ALGORITHM.
Centro de Estudios e Investigaciones Tecnicas de Guipuzcoa, San Sebastian (Spain). Dept. of Environmental Studies.
E. Ayesa, J. Florez, J. L. Garcia-Heras, and L. Larrea.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 235-247, 1991. 4 fig, 5 tab, 16 ref.

Descriptors: *Activated sludge process, *Algorithms, *Biodegradation, *Calibrations, *Kalman filtering, *Model studies, *Wastewater treatment, Activated sludge, Data interpretation, Estimating, Prediction, Simulation analysis.

An advanced identification algorithm was proposed for the on-line estimation of non-measurable state variables and coefficients of the IAWPRC biodegradation dynamic model for the Activated Sludge (AS) process. This new algorithm employs real-time measurable data and is based on a recursive non-linear extended Kalman filter that has been verified using simulated values of measurable data. These simulations describe the behavior of a specific physical configuration of the AS process under steady and transient operational conditions. When the coefficients are assumed to be known, the algorithm estimates the state rapidly and accurately, even when the measurements are affected by a high degree of noise, and the initial estimates are far from the real values. The speed of convergence of the algorithm decreases when neither the states nor the coefficients of the model are known. (See also W91-12568) (Author's abstract)
W91-12597

STOCHASTIC CONTROL OF THE ACTIVATED SLUDGE PROCESS.
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. C. Kabouris, and A. P. Georgakakos.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 249-255, 1991. 5 fig, 6 ref.

Descriptors: *Activated sludge process, *Model studies, *Stochastic models, *Wastewater treatment, Activated sludge, Data interpretation, Statistical analysis, Stochastic process, Uncertainty.

The representation of activated sludge systems by stochastic models is motivated by the presence of uncertainty associated with the random character of the input process, and on imperfect knowledge of system dynamics. A stochastic optimal control method has been developed and applied to the real-time management of an activated sludge process. The method includes a detailed dynamic process model and accounts for input uncertainty. Results from the investigation revealed that when compared with deterministic methods, stochastic approaches are more realistic and better account for the inherent input uncertainty. Thus, stochastic models provide explicit information on how uncertainties magnify or diminish as they propagate through the system. In addition, the method is computationally efficient despite the high dimensionality of the state and control variables, and can, therefore, be used in more complex problems involving additional process variables (e.g., nitrogen related elements in nutrient removal single-sludge processes). Presently, this control approach is being extended to explicitly include reliability constraints. Such constraints will facilitate the identification of control policies which guarantee that the system state and control variables do not violate certain user-defined thresholds with more than a given probability tolerance. Additional extensions include a explicit account of parameter uncertainty, and the incorporation of real-time process measurements. (See also W91-12568) (Korn-PTT)
W91-12598

EXPERT SUPPORT SYSTEM FOR COST MODELING AND EVALUATION OF WASTEWATER TREATMENT.
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
N. Galil, and Y. Levinsky.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 291-298, 1991. 8 fig, 1 tab, 23 ref.

Descriptors: *Data interpretation, *Expert systems, *Wastewater treatment, Ammonia, Costs, Energy, Organic matter, Process control, Sludge treatment, Suspended solids, Technology, Water quality.

New technological conceptions in wastewater treatment are based on analyzing sequences of physico-chemical and biological treatment process-

es. An expert support system (ESS) was proposed that would enable the examination of entire treatment sequences, each including several treatment stages and processes for sludge treatment going through all the kinetics, mass balances, and specific calculations for each separate process. The ESS was used to calculate treatment costs as a function of technical or economic parameters. It was found that parameters of pollution concentration typical to municipal wastewater (such as suspended solids, organic matter and ammonia) exert a direct linear influence on the treatment cost. The analysis of treatment sequences revealed that the more efficient is the particulate organic matter removal (achieved by primary physico-chemical processes such as hydrated lime) the lower will be the entire sequence treatment cost. This ability to analyze entire sequences may impart a significantly higher level of consideration when developing new wastewater treatment technologies. (See also W91-12568) (Author's abstract)
W91-12603

RULE-BASED EXPERT SYSTEMS IN THE CONTROL OF WASTEWATER TREATMENT SYSTEMS.
Soil and Water Ltd., Helsinki (Finland).
R. Laukkanen, and J. Pursiainen.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 299-306, 1991. 5 fig, 1 tab.

Descriptors: *Automation, *Data interpretation, *Expert systems, *Process control, *Wastewater facilities, *Wastewater treatment, Computer programs, Control policy, Finland, Performance evaluation, Training, Uncertainty.

Rule based expert systems create a low-cost solution to master all empirical knowledge available in existing wastewater treatment plants. Currently, there exists no universal model for processes of biological wastewater treatment. However, existing data records and human experience form a valuable knowledge base for an enhanced understanding of process interrelations. In spite of the natural ambiguity of human reasoning and expression, final control policy can be efficiently translated into on-line automation. Expert systems have been developed for two biological wastewater treatment facilities in Finland. Structuring of the systems was based on the application of a microcomputer based idea processor. All information was described as rules (i.e., IF...THEN...) and hierarchically organized texts were transformed into drawings, which described system activities in tree-structure fashion. The key step in the implementation of rule-based computer control was the development of techniques (e.g., fuzzy sets and hierarchical description) that enabled the system to handle typical linguistic statements used by the operators. After an acceptable period of prototype testing, the knowledge was transferred into process automation. Some important experiences noted by plant personnel include: (1) process performance has stabilized and improved; and (2) transfer of control knowledge to new operators has been more efficient than in previous times. In process control applications, knowledge must yield definite results, and uncertainty should lead to different reasoning rather than to unchanged reasoning with just a few different levels of confidence. (See also W91-12568) (Korn-PTT)
W91-12604

COMPUTERIZED BIOLOGICAL TREATMENT OPERATIONAL PROCESS CONTROL.
Stover and Associates, Stillwater, OK.
For primary bibliographic entry see Field 7C.
W91-12607

WATER AND WASTEWATER FILTRATION: A PARTICLE PERSPECTIVE.
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-12625

MITOCHONDRIAL BIOASSAY FOR TOXIC SUBSTANCES IN WATER.
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 5A.
W91-12635

IMPORTANCE OF DENITRIFICATION TO THE EFFICIENCY OF WASTEWATER TREATMENT IN FORESTED WETLANDS.
University of Southwestern Louisiana, Lafayette. Dept. of Biology.
R. R. Twilley, and R. G. Boustany.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-192369. Price codes: A04 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute, Baton Rouge, Project Completion Report, September 1990. 65p, 11 fig, 1 tab, 18 ref, append. USGS Project No. G1565-04.

Descriptors: *Denitrification, *Nitrification, *Nitrogen, *Tertiary wastewater treatment, *Wastewater treatment, *Wetlands, Dissolved oxygen, Forested wetlands, Interstitial water, Isotope studies, Redox potential, Sediment analysis.

Wastewater, even after secondary treatment, typically contains high concentrations of nutrients that can cause eutrophication of receiving waters and deterioration of water quality. Therefore, there has been much interest in the use of natural wetlands as a simple and energy-efficient means of removing nutrients from wastewater and improving water quality. The utilization of a wetland for tertiary treatment of wastewater is based on the ability of the wetland to act as a nutrient sink (i.e., outputs are less than inputs). One of the most important processes in wetland ecosystems that influences their capacity as a nitrogen sink is the gaseous exchange of nitrogen with the atmosphere, known as denitrification. Since denitrification represents a loss of nitrogen, this mechanism tends to be most favorable for the removal of nitrogen. The objectives of this research project were to (1) determine the temporal and spatial ambient rates of denitrification and compare these rates to those of sediments amended with increased concentrations of nitrate comparable to concentrations of total nitrogen in the sewage effluent to be discharged; (2) determine the proportion of total denitrification that can be attributed to direct utilization of nitrate loaded into the wetland, as compared to nitrate produced via nitrification within the wetland. Although nitrate is readily denitrified, short-term incubation rates are relatively low which is attributed to the presently low nitrate concentrations and subsequent reduced denitrifying microbial population in the wetland sediments. Nitrate concentrations varied seasonally associated with increased flooding during spring. Rates of nitrification coupled with denitrification were investigated with nitrogen-15 isotopes. Nitrification is limited in the wetland sediments; therefore, it controls the rate of total nitrogen loss from the system. Maximum rates of nitrification depend largely on oxygen availability which may be enhanced by the rooting system of certain aquatic macrophytes which provide oxygen microsites within reduced sediments. (Twilley-U Southwestern LA)
W91-12638

AQUACULTURE/MARINE FISHERIES PROCESS WASTEWATERS.
Louisiana State Univ., Baton Rouge. Cooperative Extension Service.
For primary bibliographic entry see Field 5A.
W91-12639

BENCH SCALE ROCK-PLANT FILTER INVESTIGATION.
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
D. Skipper, M. Tittlebaum, and W. Zachritz.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-192385. Price codes: A03 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute, Baton Rouge, Project Completion Report, September 1990. 21p, 9 fig, 2 tab, 10 ref. USGS Project No. G1565-05.

Descriptors: *Biochemical oxygen demand, *Rock filters, *Wastewater treatment, Anaerobic conditions, Aquatic plants, Arrowheads, Bulrushes, Chemical oxygen demand, Dissolved oxygen, Oxidation-reduction potential.

Three bench-scale rock filters containing 2 ft of gravel were used in this investigation. Two of the filters were planted with Sagittaria lancifolia and Scirpus validus, while the third filter was an unvegetated control filter. In a preliminary portion of this study, average BOD5 mass removal rates were 75%, 60%, and 44% for the Scirpus, Sagittaria, and control systems, respectively, after more than a month at a BOD5 surface loading rate of 4.96 g/day/sq m. Following this constant loading rate, an 80-day experiment was run on the filters using eight combinations of two flow rates and four influent BOD5 concentrations with each combination remaining constant for ten days. These combinations resulted in BOD5 surface loading rates from 4.63 to 30.96 g/day/sq m. Overall average BOD5 removal percentages during this latter portion of the study were 69%, 57% and 47% for the Scirpus, Sagittaria, and control systems, respectively. Oxygen reduction potential and dissolved oxygen measurements within these systems indicated no free oxygen available at any depth; however, nitrification may have occurred in the thin aerobic zone surrounding the plant root. Total Kjedahl nitrogen removal was higher in the plant systems relative to the control, with the Scirpus system achieving a higher overall removal than the Sagittaria system. (Tittlebaum-LA State U)
W91-12640

ASSESSING THE USE OF AQUATIC PLANTS FOR WASTEWATER TREATMENT IN A HIGH ELEVATION TROPICAL LAKE.
Universidad Nacional del Altiplano, Puno (Peru). Inst. de Aquas Alto Andinas.
R. C. Rivera, R. U. Kistritz, S. P. Morales, P. J. Garnica, and F. W. Zea.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1178-1182, March 1991. 5 fig, 1 tab, 10 ref.

Descriptors: *Biological wastewater treatment, *Mountain lakes, *Wastewater treatment, *Water pollution control, *Wetland wastewater treatment, Coliforms, Lake Titicaca, Peru, Pondweeds, Water pollution effects.

Baseline information on the native aquatic plants in inner Puno Bay in the Peruvian part of Lake Titicaca, was obtained (1) to determine mean standing crops and nutrient pools of littoral aquatic species occurring in inner Puno Bay; (2) to show the degree of bacterial (coliform) contamination associated with plant species, growing depths and sewer outfalls; and (3) to indicate which aquatic plant species act as an effective biofilter for sewage pollution. The pondweed Potamogeton strictus was the most productive species in terms of standing crop. The percentage of nitrogen and phosphorus per wet weight standing crop was greatest in aquatic plant species occupying shoreline regions. The shallowest plant community may be intercepting and assimilating much of the nutrient load entering the bay from city sewers. Results of total suspended coliform samples taken near the bottom along each sampling transect show high sewage pollution in the bay. Total suspended coliform bacteria numbers declined in greater depth zones. Aquatic plants provide effective attachment sites for coliform bacteria as evident from samples scraped off plant surfaces. Pondweed (P. strictus) was appropriate as a biofilter for a sewage treatment system. This species was the most productive at depths to 2 m, had relatively high tissue-nutrient levels, and supported the greatest number of coliform bacteria on its surface. An experimental constructed wetland system is being tested to determine the effectiveness of using indigenous aquatic plants for treating domestic sewage. (Brunone-PTT)
W91-12761

EFFECTS OF MEDIUM COMPOSITION ON THE BACTERIAL LEACHING OF METALS FROM DIGESTED SLUDGE.

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
R. D. Tyagi, D. Couillard, and Y. Grenier.
Environmental Pollution ENPOEK, Vol. 71, No. 1, p 57-67, 1991. 4 fig, 2 tab, 19 ref. Natural Sciences and Engineering Research Council of Canada Grant A4984, and Ministere de l'Education of the Province of Quebec Grant FCAR 87-AS-2462.

Descriptors: *Bacteria, *Biodegradation, *Leaching, *Metals, *Sludge digestion, *Sludge treatment, *Waste treatment, *Wastewater treatment, Anaerobic digestion, Iron, Iron bacteria, Thiobacillus, Waste disposal.

The effects of parameters (soluble iron, K2HPO4, MgSO4, Ca(NO3)2, KCl and (NH4)2SO4) on bacterial leaching of heavy metals from anaerobically digested sludge have been studied in a batch process using a strain of Thiobacillus ferrooxidans. The sludge was found to be a deficient iron source. Metal leaching rate was increased proportionally with the ferrous iron. Amendment of the sludge with a nitrogen source increased the metal solubilization efficiency to a very small extent. Addition of phosphate and other nutrients did not show any effect on the microbial leaching rate. (Author's abstract)
W91-12813

ELECTRICITY USE IN SMALL WASTEWATER TREATMENT PLANTS.
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
D. F. Young, and B. Koopman.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 117, No. 3, p 300-307, May/June 1991. 3 fig, 3 tab, 13 ref.

Descriptors: *Electricity, *Sludge digestion, *Wastewater facilities, *Wastewater treatment, Aerobic digestion, Biochemical oxygen demand, Electric equipment, Trickling filters.

Electrical energy consumption was documented for five wastewater treatment facilities with average flows of < 0.2 cu m/sec. Three of the plants employed activated sludge, one used trickling filter/solids contact, and one had parallel activated sludge and trickling filter trains. All digested sludge aerobically. Most of the larger motors at the facilities (5 kW or more) were operated within a load range giving optimum efficiency. Smaller motors were generally operated in very inefficient load ranges. Aeration for secondary processes or (aerobic) sludge digestion was the greatest single consumer of electrical energy, accounting for 49-97% of total plant requirements. Unit energy consumption at the facilities ranged from 0.39 to 1.17 kWh/cu m of wastewater treated, and from 3.7 to 7.2 kWh/kg BOD removed. This parameter varied inversely with the percentage of design capacity at which the plants were operated. The peaking factor for electrical demand ranged from 1.2-1.9. (Author's abstract)
W91-12819

MODIFIED SOLUTION OF HOMOGENEOUS SURFACE DIFFUSION MODEL FOR ADSORPTION.
Southern Methodist Univ., Dallas, TX. Dept. of Civil and Mechanical Engineering.
E. H. Smith.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 117, No. 3, p 320-338, May/June 1991. 6 fig, 5 tab, 24 ref, append.

Descriptors: *Adsorption, *Data interpretation, *Homogeneous surface diffusion model, *Model studies, *Wastewater treatment, Algorithms, Finite difference methods, Mathematical equations, Mathematical models, Organic compounds.

A modified finite-difference method (FDM) solution to the homogeneous surface diffusion model (HSDM) has been developed for adsorption of organic compounds from fixed beds. The new algorithm uses a different particle surface boundary condition and an alternate means of incorporating the boundary conditions into the solution of the partial differential equations (PDEs), which describe solid-phase mass balance versus the original FDM version. The modified solution eliminates the numerical integration and matrix row-reduction steps, as required by the original version, that are time-intensive and can lead, in some instances, to converge and stability problems. The modified HSDM-FDM has been shown to exhibit excellent convergence and stability properties with respect to both temporal and spatial numerical increments, owing to the exact solution of the solid-phase material balance at the boundaries. The algorithm is easy to code, readily adaptable for personal-computer use, and can generate single-component or multicomponent breakthrough profiles in substantially less time than codes using the original FDM or orthogonal collocation methods. As such, it makes a proven-useful model that retains considerable mechanistic rigor more 'accessible' to the design engineer. (Lantz-PTT)
W91-12821

DESIGNING TREATMENT BASIN DIMENSIONS TO REDUCE COST.
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
F. D. Shields, and E. L. Thackston.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 117, No. 3, p 381-386, May/June 1991. 2 fig, 2 tab, 2 ref, append.

Descriptors: *Costs, *Design standards, *Mathematical equations, *Settling basins, *Wastewater lagoons, *Wastewater treatment, Cooling ponds, Economic aspects, Mathematical studies, Oxidation ponds.

Treatment provided by large, shallow basins, such as oxidation ponds, cooling ponds, ash ponds, or dredged material settling basins, increases with retention time, although the relationship is seldom linear. The mean hydraulic retention time, t', is a function of the hydraulic efficiency (HE), in which HE = t'/T, where T=volumetric residence time = V/Q; V=basin volume and Q=mean flow rate. If a proposed basin design produces a value of t' which is too low, the designer may increase t' by increasing either T or HE. When a rectangular diked basin with inlet and outlet at the midpoints of the shorter sides is assumed, water surface area, Aw, is a length times width minus the area occupied by the spur dikes, or Aw = LW-NrLWs, where L=basin length at water surface, in feet; W=basin width at water surface, in feet; N=number of spur dikes; r=ratio of spure dike length to basin length; and Ws=width of spur dikes at water surface, in feet. A designer should pick the combination of L, W, N and r that satisfies site constraints and produces acceptable treatment at minimum cost. If Q and t' are known, and dike design has determined D, r, and w, then L, W, and N are the primary remaining geometric variables to be chosen. If sufficient land is available so that neither width nor length is constrained by site conditions, basin cost (for given values of Q, t', D, R, and W) is a function of L/W and N. If f is the ratio of the unit cost (per foot) of the spur dike to the unit cost of the perimeter dike, and if all other costs are negligible relative to the cost of the dikes and land, then basin cost may be approximated by cost = ((2L + 2W + 4w) + fNrL)Cd + ((L + 2w)(W + 2w))Cl; where w=dike width at base, Cd=the cost per unit length of the perimeter dikes, and Cl=the cost per unit area of land. (Lantz-PTT)
W91-12824

ACCUMULATION OF MERCURY BY CLADOPHORA SP. IN BRACKISH WASTE WATER (IN CHINESE).
Academia Sinica, Beijing (China). Inst. of Zoology.
Y. Gao.
Oceanologia et Limnologia Sinica (Hai Yang Yu Hu Chao) HYHCAG, Vol. 22, No. 1, p 14-20, January 1991. 5 fig, 3 tab, 14 ref. English summary.

Descriptors: *Biological wastewater treatment, *Brackish water, *Chlorophyta, *Mercury, *Wastewater treatment, Algae, Heavy metals, Metals.

The silk-like green algae Cladophora, a dominant species in Hangu Sewage Lagoon, is able to accumulate and remove mercury from brackish wastewater, and can still grow well even with 1.0 mg/L mercury in water. Signs of toxicity appear when the concentrations are higher than 2.0 mg/L for 48 hours. The mercury can be quickly accumulated by Cladophora from the brackish wastewater when fresh algae are exposed to concentrations of 0.2, 0.5, 1.0, 2.0, and 5.0 mg/L mercury. After 48 hours exposure, the contents of mercury in algae increased from initial concentrations of 0.021 mg/kg to final concentrations of 60.0 mg/kg in wastewater with 0.2 mg/L mercury, 128 mg/kg with 0.5 mg/L mercury in wastewater, 240.0 mg/kg with 1.0 mg/L mercury, 325.0 mg/kg with 2.0 mg/L mercury and 420.0 mg/kg with 5.0 mg/L mercury in wastewater. The biological accumulation factor of mercury in Cladophora was 8000 in brackish wastewater. The average removal rate of mercury from culture solution by Cladophora was 72.3% under experimental conditions; however, the removal of mercury was increased with an increase of culture solution. The accumulation and removal of mercury by Cladophora in brackish water was higher than in solution. This indicates that the mercury accumulation in Cladophora was mainly through adsorption. (Author's abstract)
W91-12833

USE OF PROTOZOA TO INDICATE CHANGES IN THE PERFORMANCE OF ACTIVATED SLUDGE PLANTS.
Leeds Univ. (England). Dept. of Civil Engineering.
S. M. Al-Shahwani, and N. J. Horan.
Water Research WATRAG, Vol. 25, No. 6, p 633-638, June 1991. 1 fig, 7 tab, 18 ref.

Descriptors: *Activated sludge process, *Bioindicators, *Biological wastewater treatment, *Microorganisms, *Protozoa, *Wastewater treatment, Activated sludge, Biological treatment, Seasonal variation, Sludge, Sludge digestion, Suspended solids, Water quality.

A quantitative and qualitative survey of microfauna at two activated sludge plants in the Leeds, England area was carried out on a weekly basis. Over an 18-month monitoring period, a wide range of species was observed belonging to three main groups; ciliates, flagellates and amoeba. Rotifers and nematodes were rarely observed. Because the predominant protozoal species occurring at each plant was a function of both the percentage occurrence and the number observed, the data was sorted on the basis of the highest percent occurrence at a concentration of 1000/mL. Results showed that the subclass peritrichia was the most important in the activated sludge process, as 14 of the 29 Ciliatea were peritrichs. Total numbers of protozoa observed in the mixed liquor ranged from 20,000 to 180,000/mL. There was little obvious seasonal variation, although the maximal populations occurred in the summer months at both plants. No correlation was observed between the occurrence of an individual species of protozoa and a change in any plant variable. Increases in the total number of protozoa in the mixed liquor suspended solids were associated with an increase in organic loading and a low sludge age. The converse was also true and at sludge ages in excess of 10 days, a large reduction in the number of protozoa was observed. One method for predicting effluent quality and operating conditions from the structure of the protozoal community was derived based on multiple regression analysis. The number of protozoa required for a successful prediction was minimized from 31 to 20 without a significant loss of accuracy using stepwise regression techniques. (Mertz-PTT)
W91-12848

CHANGES TO THE MICROBIAL ECOLOGY IN ANAEROBIC DIGESTERS TREATING ICE CREAM WASTEWATER DURING START-UP.
Birmingham Univ. (England). Dept. of Civil Engineering.
J. W. Morgan, L. M. Evison, and C. F. Forster.
Water Research WATRAG, Vol. 25, No. 6, p 639-

653, June 1991. 15 fig, 7 tab, 33 ref. SERC grant GR/E 2873.4.

Descriptors: *Anaerobic digestion, *Biological wastewater treatment, *Ecology, *Microbiological studies, *Population dynamics, *Wastewater reactors, *Wastewater treatment, Bacteria, Biological treatment, Food processing industry, Methane bacteria, Microorganisms, Statistical studies.

Changes to the microbial ecology in four different designs of pilot-scale, high rate anaerobic reactors, treating a synthetic ice cream waste, were studied during the initial start-up phase. The nature of the biomass and the numbers of non-methanogenic and methanogenic bacteria remained similar in all the digesters. Variations within the bacterial populations did occur but statistical analysis showed no significant difference between the numbers in each reactor and the time after start-up. Within the florescent methanogen population, selection of an organism tentatively identified as either Methanobacterium formicicium or a species of Methanobrevibacter occurred. Reactor design did not appear to be as important as wastewater composition in causing changes to the microbial communities. Conventional microbiological techniques still possess many limitations when applied to the study of complex microbial consortia such as those found in anaerobic digester sludge. All the methods used to enumerate the bacteria did prove problematic. Indirect bacterial enumeration techniques often greatly underestimate bacterial nu¬bers greatly because of cell clumping, the destruction of interactions between microbial species and the selectivity of the media. The Most Probable Number method used in this study to determine the number of methanogens only gives a statistical estimate of the actual numbers. (Mertz-PTT)
W91-12849

OZONATION OF PYRIDINE IN AQUEOUS SOLUTION: MECHANISTIC AND KINETIC ASPECTS.
Consiglio Nazionale delle Ricerche, Naples (Italy). Ist. di Ricerche sulla Combustione.
R. Andreozzi, A. Insola, V. Caprio, and M. G. D'Amore.
Water Research WATRAG, Vol. 25, No. 6, p 655-659, June 1991. 5 fig, 12 ref.

Descriptors: *Chemical reactors, *Kinetics, *Ozonation, *Pyridine, *Wastewater treatment, Ammonia, Hydrogen ion concentration, Liquid chromatography, Nitrogen, Nitrogen compounds, Water chemistry, Water treatment.

Direct and radicalic ozonation of pyridine in aqueous solution was investigated. Experiments were performed in a semibatch apparatus with continuous admission of ozone to the reacting solution. Reaction processes were followed using high performance liquid chromatography and chemical analyses at different ozonation times. Direct ozonation was performed by the addition of t-butanol to the reacting system to prevent radicalic development. In these conditions the ozonation of pyridine often leads to a production of pyridine N-oxide according to first-order kinetics with respect to both ozone and pyridine. Ozonation experiments at different pHs (3.0-6.0) indicate that the pyridinium ion has no appreciable reactivity toward ozone. A direct ozonation process thus occurs through the electrophilic attack of ozone on the nitrogen atom of pyridine with a rate constant $k=2.0 +/-0.3/$ moles L/sec at 298 K. Ozonation experiments that allow radicalic development of the reaction process show that pyridine oxidation occurs with a strong cleavage of the heterocyclic ring even in the initial ozonation stage. Ammonia, nitrate and amidic compounds, among which was N-formyl oxamic acid, were produced. The formation of nitroso and/or nitro derivatives could also be inferred from these experimental results. Radicalic ozonation of pyridine exhibited an autocatalytic character as shown by a rapid increase in the reaction rate in the initial ozonation stage. Autocatalysis was likely due to reaction intermediates coming from the slow direct attack of ozone on pyridine, and was capable of promoting ozone decomposition in aqueous solution. A reaction scheme based on the addition of hydroxyl radicals to the aromatic pyridine ring was proposed to explain the observed products distribution. (Author's abstract)
W91-12850

CHANGES IN PHYSICO-CHEMICAL PARAMETERS AND PHOTOSYNTHETIC MICROORGANISMS IN A DEEP WASTEWATER SELF-DEPURATION LAGOON.
Murcia Univ. (Spain). Dept. of Chemical Engineering.
A. Soler, J. Saez, M. Llorens, I. Martinez, and F. Torrella.
Water Research WATRAG, Vol. 25, No. 6, p 689-695, June 1991. 9 fig, 1 tab, 19 ref.

Descriptors: *Biological wastewater treatment, *Chlorophyta, *Cyanophyta, *Depuration, *Microbial degradation, *Protozoa, *Rotifers, *Wastewater lagoons, *Wastewater treatment, Algal blooms, Bioindicators, Copepods, Nitrates, Phosphates, Photosynthesis, Population dynamics, Spain, Species composition, Waterfleas, Zooplankton.

Temporal changes in physico-chemical parameters and photosynthetic microorganisms were studied during a seasonal cycle (October-July) in an 8 m deep self-depuration wastewater lagoon in the southeast of Spain. The mild climate of the area favors this type of water depuration. A first bloom of Chlamydomonas sp. dominated the system during the period of heavy organic contamination. This algal species disappeared without noticeable proliferation of the zooplankton grazer community. A second phase was characterized by proliferation of small chlorophytes, mainly of the genera Golenkinia, Chlorella and Scendesmus. Rotifers and ciliates grazed on this second bloom giving rise to a third one, dominated by a small cyanophyte (0.5-1.5 m) of the genus Synechococcus, when nutrient levels above the thermocline were low (2.5 mg PO4(3-)/L and 1.0 mg NH4(+)/L). The cyanophyte population was controlled by rotifers, copepods and cladocerans up to the end of the study. Two blooms of photosynthetic bacteria were identified. The first one, occupying the whole water column, coincided in time with Chlamydomonas and an organic-rich phase of the water column. It was dominated by Thiocapsa sp. and Chromatium sp., both of them sulfur red photosynthetic bacteria. The second bloom, of the green photosynthetic bacteria Chlorobium, established at and below the thermocline when H2S concentrations reached 95 mg/L. The detection of all these easily identifiable organisms has proved to be very useful as bioindicators of the water depuration stage in deep lagoons of the area. (Author's abstract)
W91-12854

EFFECTS AND DEGRADATION OF 4-CHLORO-3-CRESOL IN A SYSTEM OF NATURAL SELF-PURIFICATION.
Landesanstalt fuer Umweltschutz Baden-Wuerttemberg, Karlsruhe (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-12857

SYNCHRONOUS MICROAEROBIC AND AEROBIC DEGRADATION OF CA-LIGNOSULFONATE BY AN IMMOBILIZED MIXED CULTURE SYSTEM (MIKROBIELLER ABBAU VON LIGNINSULFONATEN UNTER MIKROAEROBEN BEDINGUNGEN).
Technische Univ., Graz (Austria). Inst. fuer Abfalltechnologie und Mikrobiologie.
V. A. Stuhlbacher.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 24, No. 2, p 57-60, April 1991. 5 fig, 1 tab, 20 ref. English summary.

Descriptors: *Aerobic digestion, *Anaerobic conditions, *Biodegradation, *Lignosulfonate, *Pulp wastes, *Wastewater treatment, Bacteria, Biological wastewater treatment, Cellulose, Effluents, Industrial wastes, Pulp and paper industry.

Ligninsulfonate is a waste product produced in large quantities by the paper and cellulose industry. The effluents from these industries have extremely adverse effects on aquatic systems. Studies of the biodegradability of Ca-lignosulfonate, using a laboratory-scaled reaction-system, showed that under microaerobic and aerobic conditions mixed populations of fungi and bacteria are able to degrade lignosulfonate at a rate of 40-60%. Under long-term conditions, the stability of the process and degradation rate decrease. (Author's abstract)
W91-12861

SLUDGE COMPOSTING ON A REGIONAL LEVEL.
North Carolina Dept. of Public Utilities, Hickory.
For primary bibliographic entry see Field 5E.
W91-12874

NITROGEN-REMOVAL ALTERNATIVES FOR WASTEWATER TREATMENT PLANT EFFLUENT.
Parametrix, Inc., Sumner, WA.
S. C. Gilbert, and R. D. Reardon.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 15-16, June 1991. 2 fig.

Descriptors: *Effluents, *Nitrogen removal, *Project planning, *Wastewater treatment, *Water pollution control, *Water quality management, Cost analysis, Decision making, Denitrification, Governmental interrelations, Trickling filters, Washington, Water quality.

A study investigating methods to remove nitrogen from wastewater treatment plant (WTP) effluent before discharge was commissioned by the Washington cities of Lacey, Olympia, and Tumwater and Thurston County (LOTT), which jointly provide wastewater treatment for their respective service areas. LOTT was directed by the Washington State Department of Ecology to begin seasonally removing by April 1, 1993, the nitrogen discharged onto Budd Inlet by the LOTT wastewater treatment plant. In the selection procedure, more than 50 options for removing nitrogen were identified by LOTT. A multi-tiered evaluation procedure was used to progressively narrow the list of alternatives to one. The first group of criteria applied to the list of alternatives was mandatory criteria such as: (1) acceptable to regulatory agency; (2) can consistently remove at least 90% nitrogen; and (3) in use at an existing facility at least one year. During the second phase of the selection process, each of the 16 remaining alternatives was ranked on a scale of 1 to 5 for its relative ability to meet 18 more specific criteria. These criteria pertained to technical issues, the natural environment, and the built environment, and were weighted according to their perceived importance to LOTT. After conceptual design, cost estimates, and ranking were completed, the information was presented to a value-engineering workshop for recommendations. The highest ranking alternatives were a nitrifying trickling filter/denitrification filter combination and the Bardenpho process. The Bardenpho alternative was recommended as the best solution for nitrogen removal for the LOTT WTP. (Agostine-PTT)
W91-12875

COMBINED SEWER OVERFLOW FACILITIES DESIGN.
Agency for Toxic Substances and Disease Registry, Atlanta, GA.
M. West, T. Moy, M. Boner, and H. Elmendorf.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 18-20, June 1991. 1 tab.

Descriptors: *Combined sewer overflows, *Design standards, *Overflow, *Sewers, *Wastewater facilities, *Wastewater management, Channels, Control systems, Design criteria, Detritus, Disinfection, Flood peak, Monitoring, Odor control, Operation, Screens, Storm runoff, Wastewater treatment, Weirs.

The city of Atlanta Georgia commissioned engineers to design and build several combined sewer overflow (CSO) treatment facilities to supplement its nine current CSO's. Design objectives included

debris removal and disinfection. Each of the five proposed CSO treatment facilities will be configured as a multi-channel screening system with a baffled diversion weir preset to divert peak flows around the screening process. The diversion weirs will accommodate all of the maximum storm flow if screen channels become blocked. The disinfection systems will also accommodate the maximum anticipated storm flows. The unit processes include coarse, mechanically cleaned bar screens; fine, dual-flow traveling water screens; and flow monitoring and liquid chemical disinfection. In addition, all sites except one will be have odor control systems. All facility pumps, motors, controls, and instrumentation will have a National Electrical Code (NEC) hazardous location rating, because of the potential for explosive gases. A stand-alone control system at each facility will allow monitoring of all unit processes, flow levels, alarm status, chemical systems, odor control systems, gas detection, intruder or personnel access detection, and other conditions. The operation of each facility will be monitored remotely by telephone link from central monitoring stations at the two Atlanta publicly owned treatment works. Each facility can also be monitored by video camera stations inside and outside the buildings. (Agostine-PTT)
W91-12876

DOUBLE CONTAINMENT IN INDUSTRIAL WASTEWATER TREATMENT PLANTS.
IBM Corp., Austin, TX.
K. Langlois, C. Bauer, and G. Woodside.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 24-25, June 1991.

Descriptors: *Design standards, *Industrial wastewater, *Pipes, *Storage tanks, *Wastewater facilities, *Wastewater management, *Wastewater treatment, Clarifiers, Costs, Operation.

Many corporations that treat their own wastewater opt for double-contained above-ground tank systems whenever a new system or an upgrade is installed. These systems are suitable for virgin or waste materials. From 1987 to 1990, the IBM plant in Austin, Tex., planned and implemented a double-containment project during an upgrade to its industrial wastewater treatment plant (WTP). The upgrade includes double-contained emergency holding and equalization tanks and a double-contained clarifier. Associated piping throughout the system is also double-contained. The design maximizes environmental protection, enhances inspectability and testability, does not compromise containment capacity, and includes leak detection systems for outdoor facilities. The cost of double containment versus single containment varies depending on the application. If two tanks are to be contained, the tank-within-pan system is the most economical, with secondary containment costing about 50% more. If one tank is being contained, the tank within-a-tank system is the most economical choice, with secondary containment costing about 110% more. Pipe in a pipe costs about 95% to 110% more than a single pipe. (Agostine-PTT)
W91-12877

VORTEX SOLIDS SEPARATOR: A NEW CSO TECHNOLOGY.
Crawford, Murphy and Tilly, Inc., Springfield, IL.
N. Wilcoxon, and C. R. Hunsinger.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 65-68, June 1991. 2 fig.

Descriptors: *Combined sewer overflows, *Solids, *Vortex solids separators, *Wastewater treatment, Economic aspects, Overflow, Physical treatment, Separation techniques, Sewers, Wastewater facilities.

The Sanitary District of Decatur (SDD), Ill., authorized a $140 million wastewater improvement program that includes the treatment of combined sewer overflow (CSO). The vortex solids separator, one of the new technologies for treating CSO, is part of Decatur's Seventh Ward CSO project and is the first installation of this design outside of Europe. The vortex solids separator removes significant amounts of pollutants from CSO's. The vortex solids separator features: a compact treatment facility, operates unattended through a wide flow variation, experiences low head loss across the unit, contains no moving parts, promotes ease of maintenance, and provides a low-cost alternative for CSO treatment. As with other swirl technologies, operation of the vortex solids separator is based on the movement of particles within each unit. Water velocity moves particles in a swirling action around the separator, additional flow currents move them toward the vortex, gravity pulls them down, and a sweeping action moves heavier particles across the sloping floor of the unit toward the central drain. (Author's abstract)
W91-12882

POTW IMPROVEMENTS RAISE WATER QUALITY.
Massachusetts Dept. of Environmental Protection, Westborough. Div. of Water Pollution Control.
R. A. Isaac.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 69-72, June 1991. 7 fig, 1 tab.

Descriptors: *Municipal wastewater, *Public utility districts, *Wastewater facilities, *Wastewater management, *Wastewater treatment, *Water quality management, Bacteria, Comparison studies, Conductivity, Dissolved oxygen, Hydrogen ion concentration, Monitoring, Organic matter, Temperature, Water quality.

The U.S. Environmental Protection Agency's (EPA's) Construction Grants Program provided approximately $39 billion in federal funds to build municipal wastewater facilities throughout the U.S. Although great strides have been made in the control of solids, bacteria, and organic materials in wastewater as a result of publicly owned treatment works (POTWs) built through the Construction Grants Program, subsequent water quality improvements have not been documented. Several fixed water quality monitoring stations were established by the Massachusetts Division of Water Pollution Control (MDWPC) in cooperation with the U.S. Geological Survey. Monitors located on the banks of six rivers, the Connecticut, Hoosie, Quinebaug, Merrimack, Nashua and Blackstone rivers between 1970 and 1980. Monitoring stations measured temperature, pH, conductivity, and dissolved oxygen (DO). The data were divided into two groups, 'before' and 'after' full operation of new or upgraded POTWs were achieved. The objective was to determine whether the average number of monthly violations (represented by the percentage of days of record during each month on which DO fell below 5 mg/L) was higher for the 'before' or 'after' data. It was found that the 'after' group were significantly lower than in the 'before' group, with greater than 95% confidence. These findings are consistent with data from intensive surveys conducted by the MDWPC from 1964 to 1989. While modest in scope, this analysis is a striking example of improved stream water quality in Massachusetts as a result of POTW upgrade and new wastewater treatment facilities done with state, local, and federal funds. (Agostine-PTT)
W91-12883

EVALUATION OF THE INHIBITORY EFFECTS OF LITHIUM WHEN USED AS A TRACER FOR ANAEROBIC DIGESTERS.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
G. K. Anderson, C. M. M. Campos, C. A. L. Chernicharo, and L. C. Smith.
Water Research WATRAG, Vol. 25, No. 7, p 755-760, July 1991. 3 fig, 4 tab, 19 ref.

Descriptors: *Anaerobic digestion, *Inhibition, *Lithium, *Microbiological studies, *Tracers, *Wastewater treatment, Digestion, Lithium chloride, Methanogens, Microbial degradation, Sludge digestion, Toxicity.

The frequent use of lithium chloride in anaerobic laboratory-scale and pilot-scale tracer studies called for an investigation into the potential inhibitory effects of the lithium ion on anaerobic sludge. A new method for measuring specific methanogenic activity (SMA) was employed to quantify these effects, and results clearly show a relationship between the degree of inhibition and the concentration of lithium. In batch studies, continuous exposure to 0.25 g Li(+)/L resulted in minor inhibition, while at 2.0 g Li(+)/L methanogenic activity virtually ceased. Temporary exposure in a continuous plug flow column had no effect at 1.0 g Li(+)/L, although the activity was reduced at 2.0 g Li(+)/L. A mechanism for this toxicity is proposed and criteria are given for tracer tests using LiCl. The success of the SMA test indicates its potential in similar field of research. (Author's abstract)
W91-12904

HYDRAULIC AND MICROBIOLOGICAL CHARACTERIZATION OF REACTORS FOR ULTRAVIOLET DISINFECTION OF SECONDARY WASTEWATER EFFLUENT.
Technische Hogeschool Delft (Netherlands). Lab. of Sanitary Engineering.
T. J. Nieuwstad, A. H. Havelaar, and M. Van Olphen.
Water Research WATRAG, Vol. 25, No. 7, p 775-783, July 1991. 4 fig, 8 tab, 37 ref.

Descriptors: *Disinfection, *Microbiological studies, *Ultraviolet disinfection, *Wastewater reactors, *Wastewater treatment, Bacteriophage, Kinetics, Microbial degradation, Model studies, Viruses, Wastewater treatment facilities.

The efficiency of 5 different types of UV reactors for disinfecting secondary effluent was tested in continuous experiments lasting 4-10 wks. The units were hydraulically characterized by tracer studies and microbiologically calibrated by measuring the inactivation of a model organism, for which the F-specific RNA bacteriophage MS2 was used. All units could be described as a number of organisms and the average UV dose. The UV dose could be calculated from the product of the average retention time and the average UV intensity in the reactor. The average UV intensity could be calculated using the infinite line source model and the extinction coefficient of the water measured in unfiltered samples, which varied between 90 and 140/m (transmittance 1 cm cuvette between 25 and 40%). From experiments with naturally polluted secondary effluent the inactivation rate constant for the vegetative bacteria E. coli was 0.0055 sq m/J, and for fecal streptococci was 0.0029 sq m/J. For the bacterial spores of sulfite-reducing clostridia this constant was 0.00063 sq m/J and for somatic coliphages and F-specific bacteriophages values of 0.0069 and 0.0023 sq m/J were found. Enteroviruses were usually inactivated below the level of detection (1 PFU/10 L), hence no quantitative results can be presented. The inactivation rate constant for retroviruses was 0.0024 sq m/J, very close to the constant for F-specific bacteriophages, which makes the latter organisms, which are relatively easy to count, very suitable as an indicator organism for virus inactivation by UV radiation. The inactivation rate constant for a pure culture of MS2 was 0.0046 which is twice the value for F-specific phages as naturally occurring in sewage. This emphasizes the need to design UV reactors on the basis of data obtained with effluents rather than laboratory-strains of microorganisms. (Author's abstract)
W91-12906

ANAEROBIC DIGESTION OF HIGH STRENGTH MOLASSES WASTEWATER USING HYBRID ANAEROBIC BAFFLED REACTOR.
ENEA, Bologna (Italy).
R. Boopathy, and A. Tilche.
Water Research WATRAG, Vol. 25, No. 7, p 785-790, July 1991. 5 fig, 3 tab, 15 ref.

Descriptors: *Anaerobic digestion, *Wastewater reactors, *Wastewater treatment, Biomass, Chemical oxygen demand, Digestion, Methane bacteria, Microbial degradation, Nitrogen, Nutrients, Phosphorus.

The anaerobic digestion of high strength molasses wastewater (molasses alcohol stillage and raw molasses) in a hybrid anaerobic baffled reactor was

studied. At an organic loading rate of 20 kg COD/cu m/day, the reactor performed effectively achieving total and soluble COD removals in excess of 70%. Granulation of biomass was observed in the reactor and the granules grew in size with time as the experiment progressed. The predominant methanogens similar to Methanothrix and Methanosarcina species were observed in the granules. Nitrogen and phosphorus were supplemented whenever needed. Biomass retention inside the reactor was very good. Gas production was 5 v/v of the reactor/day. (Author's abstract)
W91-12907

SYNCHRONIZED DIVISION OF ACTIVATED SLUDGE MICROORGANISMS.
Institut National des Sciences Appliquees, Toulouse (France). Dept. 'Genie des Procedes Industriels'.
P. Chudoba, J. Chang, and B. Capdeville.
Water Research WATRAG, Vol. 25, No. 7, p 817-822, July 1991. 9 fig, 2 tab, 22 ref.

Descriptors: *Activated sludge process, *Cell division, *Microbiological studies, *Synchronization, *Wastewater treatment, Activated sludge, Anaerobic digestion, Biomass, Microbial degradation.

Two laboratory continuous activated sludge units were run. One unit was an oxic-settling anaerobic (OSA) system with anaerobic stabilization of returned sludge, and the other a conventional activated sludge (CAS) system operated as a control unit. Excess biomass from both systems was used as inoculum for batch experiments in order to study the kinetic behavior of microorganisms originally grown in oxic-anaerobic conditions. All experiments were carried out with synthetic wastewater. Biomass growth, substrate removal, oxygen uptake and carbon dioxide production were measured using a quadrupole mass spectrometer (Inficon IQ 200) coupled to a 15-1. fermentor (Biolafitte). The results showed that at initial substrate to initial biomass (So/Xo) ratios higher than 2, cell division occurred, which was demonstrated by an acceleration of substrate removal and biomass growth rates. This division was synchronized (simultaneously occurring cell multiplication) in the case of activated sludge from the OSA unit. The synchronization was induced by periodical exposure of the microorganisms to unfavorable conditions of growth due to starvation under anaerobic conditions. The primary aim of this paper is to point out the existence of synchronized cell division in certain laboratory activated sludge systems, and to determine the conditions under which this phenomenon can occur. (Author's abstract)
W91-12911

DENSITY OF ACTIVATED SLUDGE SOLIDS.
California Univ., Davis. Dept. of Civil Engineering.
E. E. Dammel, and E. D. Schroeder.
Water Research WATRAG, Vol. 25, No. 7, p 841-846, July 1991. 7 fig, 5 tab, 15 ref.

Descriptors: *Activated sludge process, *Density, *Sludge solids, *Wastewater treatment, Biological wastewater treatment, Centrifugation, Physical treatment, Sludge digestion.

Along with particle size and shape, solids density is a factor in the removal efficiency of secondary clarifiers. Density gradient centrifugation, a technique widely used in the biological sciences, was adapted to measure the density of activated sludge solids. Density gradient centrifugation consists of allowing the solid particles to settle in a fluid of continuously increasing density until the particles become stationary. At this point, both particle and fluid densities are equal. This technique was used to measure the density of activated sludge solids at several treatment plants in the Sacramento area. The density of activated sludge solids at a given treatment plant over a period of time was relatively constant. However, at different treatment plants, densities ranged from a low of 1.02 to a high of 1.06 gm/mL, indicating that plant operations may influence solids density. Using the measured density of secondary solids, variation in settling velocities was estimated using the following assumptions: (1) discrete particle settling; (2) an average particle diameter of 100 microm; and (3) laminar flow conditions. The corresponding settling velocities for particles with densities of 1.02 and 1.06 gm/mL are 16.9-26.8 m/day. (Author's abstract)
W91-12915

DYNAMIC MODELLING OF A SINGLE-STAGE HIGH-RATE ANAEROBIC REACTOR--I. MODEL DERIVATION.
Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
D. J. Costello, P. F. Greenfield, and P. L. Lee.
Water Research WATRAG, Vol. 25, No. 7, p 847-858, July 1991. 3 fig, 2 tab, 32 ref.

Descriptors: *Anaerobic digestion, *Mathematical models, *Model studies, *Wastewater reactors, *Wastewater treatment, Bacteria, Biological wastewater treatment, Hydrogen ion concentration, Lactic acid, Physicochemical properties.

A mathematical model of a high-rate anaerobic treatment system was developed by defining the biological make-up of the anaerobic ecosystem, the physicochemical system, and the reactor process. The biological model was extended from current theory to include the accumulation of lactic acid under specific process conditions. Product inhibition and pH inhibition of each group of bacteria were represented in the model so as to utilize all the available information about the anaerobic process. A rigorous approach was applied to the development of the physicochemical model which was then used to determine the reactor pH and ionic species concentrations. The overall reactor equations were based on continuous well-mixed processes, with no effective solids residence time parameter introduced to account for bacterial retention in the process. Parameters were taken from models developed by previous researchers, and from mixed and pure culture studies of the anaerobic bacteria. (See also W91-12917) (Author's abstract)
W91-12916

DYNAMIC MODELLING OF A SINGLE-STAGE HIGH-RATE ANAEROBIC REACTOR--II. MODEL VERIFICATION.
Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
D. J. Costello, P. F. Greenfield, and P. L. Lee.
Water Research WATRAG, Vol. 25, No. 7, p 859-871, July 1991. 7 fig, 6 tab, 31 ref.

Descriptors: *Anaerobic digestion, *Mathematical models, *Model studies, *Wastewater reactors, *Wastewater treatment, Bacteria, Biological wastewater treatment, Hydrogen ion concentration, Lactic acid, Physicochemical properties.

A structured model of the anaerobic degradation process, incorporating dynamic equations for the description of a single-stage high-rate anaerobic reactor, was validated by comparing its predictions with previously reported experimental data. This data came from two different laboratory-scale reactors and a pilot-scale reactor. With the manipulation of key model parameters, significant improvements in the fit of the model to the experimental data were possible. This study was able to show that the production and consumption of lactic acid, and the moderate hydrogen inhibition and regulation of the acidic products of the acidogenic bacteria, can be successfully modeled. Insufficient experimental data were available to draw conclusions as to the importance of product inhibition in anaerobic reactors, while the need to use deterministic models to account for pH inhibition highlighted the need to develop mechanistic models able to reflect the pH inhibited behavior of the major anaerobic groups present in the ecosystem. (See also W91-12916) (Author's abstract)
W91-12917

BIODEGRADATION KINETICS OF CHLORINATED ALIPHATIC HYDROCARBONS WITH METHANE OXIDIZING BACTERIA IN AN AEROBIC FIXED BIOFILM REACTOR.
Technical Univ. of Denmark, Lyngby. Dept. of Environmental Engineering.
E. Arvin.
Water Research WATRAG, Vol. 25, No. 7, p 873-881, July 1991. 8 fig, 3 tab, 30 ref.

Descriptors: *Aerobic treatment, *Biodegradation, *Biological wastewater treatment, *Chlorinated hydrocarbons, *Fixed film processes, *Kinetics, *Methane bacteria, *Wastewater treatment, Aliphatic hydrocarbons, Bacteria, Biological treatment, Dichloroethene, Hydrocarbons, Organic compounds, Trichloroethane, Trichloroethene.

The kinetics of trichloroethene (TCE), 1,1,1-trichloroethane (TCA), cis-1,2-dichloroethene (c-1,2-DCE) and trans-1,2-dichloroethene (t-1,2-DCE) were determined by using a completely mixed laboratory biofilm reactor seeded with methane-oxidizing (methanotrophic) bacteria originally obtained from an aquifer contaminated with chlorinated hydrocarbons. The contaminant degradation followed first-order kinetics in the concentration range 0-1 mg/L. TCA was degraded with the same reaction rate as TCE. In other studies with methanotrophic bacteria, TCA appear to be nonbiodegradable. In general, the degradation of TCE, TCA and c-1,2-DCE was relatively slow at 20-24 C, whereas t-1,2-DCE was transformed relatively fast. The growth of methane oxidizing bacteria in the biofilm was studied. The biofilm thickness increased linearly for a constant loading of methane. The formation of c-1,2-DCE epoxide was presumably an intermediate from c-1,2-DCE degradation, and t-1,2-DCE epoxide was probably formed from t-1,2-DCE. This work indicates that in order to make aerobic degradation of the chlorinated hydrocarbons practically feasible, methods are required which would increase the biodegradation rate of TCE, TCA and c-1,2-DCE. (Author's abstract)
W91-12918

SPREADSHEET-BASED BOX MODEL TO PREDICT THE FATE OF XENOBIOTICS IN A MUNICIPAL WASTEWATER TREATMENT PLANT.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Ecotoxicology, Environmental Chemistry and Drinking Water.
J. Struijs, J. Stoltenkamp, and D. Van de Meent.
Water Research WATRAG, Vol. 25, No. 7, p 891-900, July 1991. 6 fig, 9 tab, 21 ref.

Descriptors: *Biodegradation, *Computer programs, *Model studies, *Wastewater treatment, *Wastewater treatment facilities, *Xenobiotics, Chemical reactions, Municipal wastewater, Spreadsheets.

A non-equilibrium steady-state box model has been developed that predicts the fate of new chemicals in a conventional sewage treatment plant from a minimal input data set. The model, written in an electronic spreadsheet (Lotus 1-2-3), requires a minimum input: some basic properties of the chemical, its emission rate and a few parameters to account for the scale and mode of operation of the plant. Compound properties necessary as input are air-water and sludge solids-water partition coefficients. If these distribution coefficients are not available but the compound is hydrophobic, default values are calculated from input such as solubility, vapor pressure and octanol-water partition coefficient. Biodegradability data and the degree of dissociation or protonation are the required input data to account for degradation and speciation changes of the chemical in the water phase. The modeled sewage treatment installation consists of primary sedimentation and the activated sludge technique. The standard output shows the chemical's concentration in effluent and sludge. In addition the output contains the relative amounts degraded and emitted via effluent, sludge and air. The main advantage of this approach i s that it provides legislators with a quick insight if a chemical will be an air, water or sludge pollutant when it is discharged into sewage works at a certain rate. Examples are evaluated and results are compared with measured concentrations. Volatilization rates derived from reported field data are in good agree-

ment with predicted emissions to the atmosphere. (Author's abstract)
W91-11920

5E. Ultimate Disposal Of Wastes

SOIL AND SWEET CHERRY RESPONSES TO IRRIGATION WITH WASTEWATER.
Agriculture Canada, Summerland (British Columbia). Research Station.
G. H. Neilsen, D. S. Stevenson, J. J. Fitzpatrick, and C. H. Brownlee.
Canadian Journal of Soil Science CJSSAR, Vol. 71, No. 1, p 31-41, January/February 1991. 3 fig, 5 tab, 24 ref.

Descriptors: *Cherry trees, *Land disposal, *Loam, *Sandy soils, *Wastewater disposal, *Wastewater irrigation, Boron, Calcium, Conductivity, Hydrogen ion concentration, Magnesium, Municipal wastewater, Nitrogen, Nutrients, Phosphorus, Plant growth, Potassium, Secondary wastewater, Well water, Zinc.

The rural municipality of Osoyoos, British Columbia, developed a program in the 1970s and 1980s of disposing secondary treated municipal wastewater by land application. The effects of wastewater disposal on tree fruits were assessed by establishing experimental plots irrigated with either wastewater or well water. Lambert sweet cherry (Prunus avium L.) established on loamy sand in 1983 was subjected to treatments involving all combinations of two types of irrigation (well water or municipal wastewater) and three rates of N fertilization (0, 68 and 136 g of N as NH4NO3/tree/yr), 1984-87. The zero-N treatment was increased to 34 g N/tree in 1986-87. Wastewater irrigation increased leaf N, P, K, B, and Mn concentration, decreased leaf Mg and Ca and had few consistent effects on leaf Fe and Cu. Tree growth was increased after 2 yr but not after 5 yr by wastewater irrigation. Inadequate N and Zn nutrition appeared to limit long-term tree growth. After 5 yr, wastewater-irrigated soils had higher extractable P, K, and B and lower Ca and Mg than well-water-irrigated soils which had higher Ca and Mg to 0.9-m depth. Wastewater irrigation also increased extractable Na throughout the soil but insufficiently to adversely affect tree growth. Soil pH and electrical conductivity also increased during the experiment for both well-, and wastewater-irrigated soils, but these increases did not cause alkalinity or salinity problems. (Author's abstract)
W91-11653

MODEL STANDARDIZED RISK ASSESSMENT PROTOCOL FOR USE WITH HAZARDOUS WASTE SITES.
Pittsburgh Univ., PA. Dept. of Biostatistics.
G. M. Marsh, and R. Day.
Environmental Health Perspectives EVHPAZ, Vol. 90, p 190-208, 1991. 5 fig, 1 tab, 12 ref, append.

Descriptors: *Decision making, *Hazardous wastes, *Model studies, *Public health, *Risk assessment, *Waste disposal, Path of pollutants, Public participation, Public policy, Site selection, Waste management.

A model standardized risk assessment protocol (SRAP) for use with hazardous waste sites was proposed that focused on the degree and patterns of evidence that exist for a significant risk to human populations from exposure to a hazardous waste site. The SRAP was designed with at least four specific goals in mind: (1) to organize the available scientific data on a specific site and to highlight important gaps in this knowledge; (2) to facilitate rational, cost-effective decision making about the best distribution of available manpower and resources; (3) to systematically classify sites according to the level of risk they pose to surrounding human populations; and (4) to promote an improved level of communication among professionals working in the area of waste site management, and between decision makers and the local populations. This method for the classification of hazardous wastes sites, one that logically relates patterns of health risk to potential ameliorative actions, may play an important role in reducing or controlling expressed levels of public anger and suspicion. If potentially exposed communities perceive that public health officials have standardized and reliable methods for assessing the extent of the health risks posed by hazardous waste sites, and if the results of such investigations can be communicated to the public on a routine and timely basis, it may be possible in the future to achieve improved public cooperation and confidence, and to promote an atmosphere more conducive to the conduct of the scientific activities necessary to measure true potential risks from the release of toxic substances. (Author's abstract)
W91-11679

BANGKOK METROPOLITAN WASTE WATER AND REFUSE PROBLEMS.
Bangkok Metropolitan Administration (Thailand). Infrastructure and Environment Div.
K. Suwarnarat.
Water Resources Journal, Vol. 165, p 19-23, June 1990. 3 tab, 10 ref.

Descriptors: *Bangkok, *Waste disposal, *Waste management, *Wastewater treatment, Costs, Economic aspects, Flooding, Thailand, Urbanization, Wastewater management.

The magnitude of future population growth in Thailand is uncertain, dependent as it is on the extent of migration from rural areas. Nevertheless, the best estimate is that the population of the Bangkok Metropolitan Area (BMA) will increase by 3.4 million (41%) over the next 15 years, from 8.2 million in 1986 to 11.5 million in 2001: a growth rate of 2.3%/yr compared with 1.4%/yr for the country as a whole. Only 60% of the population is at present covered by the service of the Metropolitan Water Works Authority which is a special agency under the Ministry of the Interior. The main source is the surface water from the Chao Phraya River which is becoming inadequate in the dry season, in addition to being badly polluted. A large amount of the treated water is lost in the system. While losses of 25% are considered to be normal, the leakage in Bangkok is as high as 40%. Because of flooding and poor maintenance, the Bangkok BMA refuse disposal sites are far from able to meet Bangkok's refuse disposal needs. Located in the suburban areas of Bangkok, the dumps only have long distance access to the drainage canals, and the extra leachate from the refuse dumps is a problem which is not yet being properly managed. The high rate of land subsidence is worsening the situation to the extent that gravity drainage is impossible. The flood control master-plan studies indicate that Bangkok will need 2-3 cu m/sec pumping capacity to prevent storm water flooding. Therefore, the potential need of 3,000 to 4,500 cu m/sec of pumps can be visualized. Each cu m/sec will need about 50 kW driving power. While the BMA has not been able to realize a major implementation of sewage treatment within Bangkok, except for hospital sewage purification plants, the National Housing Authority (NHA) has been somewhat more successful. It has built 16 community sewage works serving about 100,000 people; however, plant maintenance has not been completely successful. (Lantz-PTT)
W91-11802

ALTERNATIVE WASTE TREATMENT SYSTEMS.
For primary bibliographic entry see Field 5D.
W91-11805

IRRIGATION OF HIGH-NITROGEN CONTAINING WASTES TO PASTURE.
Meat Industry Research Inst. of New Zealand, Hamilton.
For primary bibliographic entry see Field 3F.
W91-11810

DISPOSAL OF PULP AND PAPER MILL EFFLUENTS BY SPRAY IRRIGATION ONTO FARMLAND.
Tasman Pulp and Paper Co. Ltd., Kawerau (New Zealand). Technical Dept.
B. Johnson, and T. Ryder.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 55-66, 4 fig, 8 tab, 5 ref.

Descriptors: *Pulp and paper industry, *Spray irrigation, *Wastewater irrigation, Biomass, Irrigation practices, Pasture management, Productivity, Wastewater disposal, Wastewater treatment.

Regulatory requirements facing the pulp and paper industry's waste management are becoming more stringent, making it necessary to investigate alternative treatment processes. Spray irrigation is one of several methods available for the disposal of kraft mill effluent by application onto land. The Tasman Pulp and Paper Company Limited is currently engaged in a trial to evaluate the disposal of treated mill effluent by spray irrigation. Spray irrigation is seen as a supplement to Tasman's existing treatment system and as a means to reduce the effluent loading to the Tarawera River, particularly in the summer months when river assimilative capacity is low. Treated pulp and paper mill waste was sprayed onto a representative three-hectare paddock of existing pasture, at an application rate of 0-11 m/ha/yr. To date, the spray irrigation has provided large pasture growth response in summer, improved the pasture composition, and significantly reduced the major components of the effluent, namely biological oxygen demand, sodium, sulfur, and color. (See also W91-11805) (Fish-PTT)
W91-11811

DISPOSAL OF AGRICULTURAL LIQUID WASTE BY SUB-SOIL INJECTION.
Massey Univ., Palmerston North (New Zealand). Agricultural Machinery Research Centre.
M. A. Choudhary, C. J. Baker, L. D. Currie, and T. J. Lynch.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 82-92, 4 fig, 4 tab, 10 ref.

Descriptors: *Farm wastes, *Liquid wastes, *Soil treatment, *Waste disposal, *Wastewater disposal, Agricultural practices, Agricultural runoff, Blood, Farm management, Nitrogen, Pasture management.

The runoff from farm animal wastes is considered to be a major contributor to water pollution. The design parameters and field performance of a liquid waste injection machine for shallow subsoil placement were examined. Field experiments were conducted to determine the effects on pasture growth from subsoil injection and surface broadcast of liquid cow and pig wastes and animal blood at nutrient rates of 25 kg N/ha, and blood at 317 kg N/ha, and equivalent broadcast dry inorganic fertilizer. The injector was found to adequately dispose of liquid waste in the subsoil at 75 mm depth. No sustainable responses in pasture growth occurred when 25 kg N/ha of wastes or dry fertilizer were injected or surface applied. A significant increase in pasture growth was obtained when blood or dry fertilizer at 317 kg N/ha was applied. Pasture growth responses continued over longer periods when blood was injected at this rate than when it was surface applied, suggesting that better nutrient conservation occurred when wastes were placed in the subsoil. (See also W91-11805) (Author's abstract)
W91-11813

DESIGN CRITERIA FOR WASTEWATER INFILTRATION SYSTEMS.
Norges Landbrukshoegskole, Aas. Inst. for Georesources and Pollution Research.
For primary bibliographic entry see Field 5D.
W91-11814

USE OF AEROBIC THERMOPHILIC COMPOSTING FOR THE STABILISATION OF PRIMARY MEAT WASTE SOLIDS.
Canterbury Frozen Meat Co. Ltd., Christchurch (New Zealand).

For primary bibliographic entry see Field 5D.
W91-11816

DRYING OF SEWAGE SLUDGE BY AEROBIC SOLID STATE CULTIVATION.
Osaka City Univ. (Japan). Faculty of Science.
For primary bibliographic entry see Field 5D.
W91-11817

ON-SITE HYBRID ANAEROBIC TREATMENT OF PARTICULATED POULTRY WASTES.
Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W91-11818

TEMPERATURE-CONTROLLED, AERATED STATIC-PILE COMPOSTING OF SLAUGHTERHOUSE WASTE SOLIDS.
Meat Industry Research Inst. of New Zealand, Hamilton.
For primary bibliographic entry see Field 5D.
W91-11820

AQUEOUS WASTE SUBSTITUTION IN THE MANUFACTURE OF GIANT CEMENT AS A LOW-COST REUSE AND DISPOSAL OPTION.
For primary bibliographic entry see Field 5D.
W91-11821

EVAPO-TRANSPIRATION FOR ON-SITE RESIDENTIAL WASTEWATER DISPOSAL--THE NEW ZEALAND EXPERIENCE.
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-11822

MICROBIOLOGICAL TREATMENT OF BREWERY WASTE FOR RESOURCE RECOVERY.
National Univ. of Singapore. Dept. of Microbiology.
T. S. Sim, J. C. S. Oh, and A. L. Chng.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 209-218, 3 fig, 2 tab, 19 ref.

Descriptors: *Barley, *Food-processing wastes, *Microbial degradation, *Singapore, *Waste recovery, *Waste treatment, *Waste utilization, Amino acids, Enzymes, Feeds, Fungi, Hydrolysis, Proteins, Sugars.

In Singapore, barley grains are usually discarded at the end of the brewing process. Although waste grains are widely used as cattle fodder, the scarcity of cattle farming in Singapore limits its use. Since the main livestock are poultry and fish, there is a necessity for an investigation into alternative, effective, and economical methods of converting spent grains into partially hydrolyzed feedstock. Spent brewery grains were microbiologically treated by the cultivation of the cellulolytic fungus Trichoderma reesei QM9414 for the production of microbial resources such as cellulase enzymes, sugars, and proteins. Cellulase levels were maximal after 2-4 days cultivation while sugar levels in the grains medium was raised to 3% after growth. Hydrolysis of fresh grain substrate using crude enzyme extracts yielded 7.5% sugars. Maximal soluble protein levels were obtained after 4-7 days growth coupled with improvements in certain amino acid levels, thus indicating the potential of microbiologically treated spent grains as a feed supplement. A practical aspect of this system is the possibility of using the spent grains discharged by the breweries per se for reutilization as an animal feed supplement. (See also W91-11805) (Author's abstract)
W91-11823

ENVIRONMENTAL EFFECTS OF DREDGING: MANAGING DREDGED MATERIAL: EVALUATION OF DISPOSAL ALTERNATIVES IN THE NEW YORK-NEW JERSEY METROPOLITAN REGION.
Army Engineer District, New York.
D. Freeman.
Available from the Department of the Army, Waterways Experiment Station, Corps of Engineers, 3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199, Army Corps of Engineers, Information Exchange Bulletin Vol D-90-3, Dec 1990. 3 fig.

Descriptors: *Dredging, *Dredging wastes, *Ocean dumping, *Waste disposal, *Waste management, Borrow pits, Harbors, Landfills, Navigation channels, New Jersey, New York, Sediment contamination, Spoil disposal, Waste dumps.

Periodic dredging and maintenance of navigation channels in the New York Harbor are essential for both commercial and recreational vessels, which need up to 45-foot depths to enter the harbor. Dredging is also a way to obtain sand which is used for construction purposes and to restore beaches damaged by storms, tides, and erosion. There is no single alternative that can handle all dredged material from the Harbor for more than a few years. Ocean dumping has been found to be the only alternative that is both economically feasible and environmentally safe for large volumes of clean material. Since 1914, most of the dredged material generated has been disposed in the ocean at the Mud Dump Site, 6 miles east of Sandy Hook, New Jersey, carefully monitored by the US Army Corps of Engineers. For material than cannot be ocean disposed without capping, borrow pits, underwater sand and gravel pits left in the harbor after sand mining has been completed which can subsequently be filled with muddy sediment and then capped, seem the most likely alternative that could be implemented relatively quickly. Containment islands, confined facilities in the water within diked areas, should be seriously considered as a long-term alternative. Land disposal, particularly when combined with sanitary landfill cover, will be used in special cases, such as for high levels of contamination. (Fish-PTT)
W91-11827

ON-SITE SEWAGE DISPOSAL--THE INFLUENCE OF SYSTEM DENSITY ON WATER QUALITY.
Illinois Univ., Urbana. Dept. of Agronomy.
T. J. Bicki, and R. B. Brown.
Journal of Environmental Health JEVHAH, Vol. 53, No. 5, p 39-42, March/April 1991. 36 ref.

Descriptors: *Drainage density, *Groundwater pollution, *On-site waste disposal, *Septic drain fields, *Water pollution sources, Drainage systems, Groundwater quality, Nitrates, Wastewater disposal, Wastewater pollution.

Population density determines the effluent load per unit land area and the concentration of contaminants in groundwater. Numerous studies employing groundwater monitoring and modeling have demonstrated a correlation between water contamination and on-site sewage disposal density. A survey of literature on density of systems indicates that in general a minimum lot size of one-half to one acre is needed to ensure against groundwater contamination. However, some studies have found groundwater contamination from nitrate with lot sizes in this range due to site specific soil, hydrogeologic and climate conditions. Most studies relating density of on-site sewage disposal systems to groundwater contamination have focused on nitrate loading. Additional research focusing on other effluent constituents is needed to improve our understanding of system density and water quality. (Author's abstract)
W91-11970

CHAMBER LEACHFIELD SYSTEMS, AN ALTERNATIVE TO CONVENTIONAL GRAVEL-FILLED SYSTEMS.
R. May.
Journal of Environmental Health JEVHAH, Vol. 53, No. 5, p 43-44, March/April 1991. 13 ref.

Descriptors: *Chamber leachfield systems, *Gravel packing, *On-site wastewater treatment, *Septic drain fields, *Wastewater disposal, Drainage systems, Leaching, Seepage pits, Soil compaction, Soil permeability.

Conventional septic system leachfields normally have been constructed utilizing gravel-filled trenches beds. However, gravel has potential damaging impacts: compaction of moist soil by weight and velocity of gravel during installation, creation of a low permeability layer by fines entrained with gravel, physical obstruction of the soil interface and the potential for high BODs and SS loadings in the stone voids at the soil interface. Open-bottom chamber systems offer ease of construction and inspection, high storage volumes and eliminate the negative impacts of stone gravel. A significant body of data supports the conclusion that a leachfield system that does not cover the soil interface with gravel can outperform the comparable gravel-covered interface by a factor of more than 2 to 1. This factor has been used in several states which allow installation of chamber systems sized at 50-60% of conventional gravel systems. This practice has not resulted in any documented problems and, in one large study, has been supported as superior to conventional practice. (Author's abstract)
W91-11971

SLUDGE REGULATIONS STRESS BENEFICIAL USE.
The Chester Engineers, Pittsburg, PA.
For primary bibliographic entry see Field 5G.
W91-11990

RCRA GIVES TSDFS NO ROOM FOR ERROR.
Little (Arthur D.), Inc., Cambridge, MA.
For primary bibliographic entry see Field 5G.
W91-11992

ELECTRICITY SEALS IMPOUNDMENT LEAKS.
Southwest Research Inst., San Antonio, TX. Environment and Geophysical Applications Section.
For primary bibliographic entry see Field 5G.
W91-11993

CHEMICAL FRACTIONATION AND PLANT UPTAKE OF HEAVY METALS IN SOILS AMENDED WITH CO-COMPOSTED SEWAGE SLUDGE.
Delaware Univ., Newark. Dept. of Plant Science.
For primary bibliographic entry see Field 5B.
W91-11997

MODEL SCALING LAWS FOR TUNNELED OCEAN-SEWAGE OUTFALLS.
New South Wales Univ., Kensington (Australia). Water Research Lab.
For primary bibliographic entry see Field 8B.
W91-12050

VOC EMISSIONS AND ASSOCIATED HEALTH RISKS.
Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA.
J. J. Vasconcelos, L. Y. C. Leong, and J. E. Smith.
Water Environment & Technology WAETEJ, Vol. 3, No. 5, p 47-50, May 1991. 4 tab.

Descriptors: *Air pollution, *Air pollution effects, *Public health, *Volatile organic compounds, *Wastewater facilities, *Wastewater renovation, *Wastewater treatment, Activated carbon, Carcinogens, Filters, Models, Permits, Risk assessment.

An air-quality impact analysis and a cancer-risk assessment were performed for the Moulton Niguel Water District (MNWD), which was applying for an air-quality permit to construct and operate an odor-reducing tower at a wastewater reclamation plant in Mission Viejo, California. The headworks and primary tanks of MNWD will be covered and the off-gases will be collected and treated in a fixed-film biological scrubbing tower using primary effluent. The gas stream will then be

de-misted and passed through granulated activated-carbon filters before discharge to the atmosphere. An approved complex-terrain screening model estimated air-quality impacts of the odor-reducing tower. Based on the results of the coarse receptor grid screening, the fine receptor grid determined the location and magnitude of the maximum annual ground-level concentration and the impacts on the surrounding residential areas. A unit mass emission rate of 1 g/sec was used for all model runs. Results of modeling runs were than scaled for each contaminant of concern based on respective estimated mass emission rates. Emission rates for each contaminant were estimated by analyzing for the liquid phase concentrations in a 24-hr flow composite wastewater sample taken from the plant influent sewer and estimating VOC emissions that might occur in the proposed facility. The coarse receptor grid analysis predicted that the highest concentrations would be found west and slightly south of the source and that the concentration decreased by an order of magnitude within a radius of about 0.8 km of the source. For the fine receptor grid analysis, at a unit emission rate of 1 g/sec, the maximum predicted off-site concentration was 37.2 micrograms/cu m at a distance of 100 m west of the source in an existing business park. The excess cancer burden for each detected compound and the total cancer burden were calculated for each census tract within the impacted area. Results indicated that an excess total cancer burden of 0.01615 total excess cancer cases would result from exposure, which is below the South Coast Air Quality Management District limit of 0.5 excess cases. (Geiger-PTT)
W91-12077

LEACHATE TREATMENT IN LANDFILLS.
SCS Engineers, Inc., Long Beach, CA.
For primary bibliographic entry see Field 5G.
W91-12081

FATE OF INDICATOR ORGANISMS IN SLUDGE DURING BACTERIAL LEACHING OF METALS.
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-12084

CONTAMINANT IMPACT ASSESSMENT AND THE CONTAMINATING LIFESPAN OF LANDFILLS.
University of Western Ontario, London. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-12085

FINITE DIFFERENCE MODELLING OF THE VARIATION IN PIEZOMETRIC HEAD WITHIN A ROCKFILL EMBANKMENT.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-12086

CHEMICAL CHARACTERIZATION OF POLYCYCLIC AROMATIC HYDROCARBON MIXTURES IN UNCONTROLLED HAZARDOUS WASTE DUMPS.
Centro de Investigacion y Desarrollo, Barcelona (Spain). Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 5A.
W91-12147

RISK ASSESSMENT WITH LOWER PROBABILITIES: APPLICATION TO TOXIC WASTES.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5G.
W91-12288

COMPARATIVE ASSESSMENT OF THE CHEMICAL AND ADSORPTIVE CHARACTERISTICS OF LEACHATES FROM A MUNICIPAL AND AN INDUSTRIAL LANDFILL.
Southern Methodist Univ., Dallas, TX. Dept. of Civil and Mechanical Engineering.
For primary bibliographic entry see Field 5B.
W91-12297

SUBSURFACE LEACHATE MIGRATION FROM A REJECT COAL PILE IN SOUTH CAROLINA.
Savannah River Ecology Lab., Aiken, SC. Div. of Biogeochemical Ecology.
For primary bibliographic entry see Field 5B.
W91-12300

COMPARISON OF LABORATORY BATCH METHODS AND LARGE COLUMNS FOR EVALUATING LEACHATE FROM MONO-FILLED SOLID WASTES.
Radian Corp., Austin, TX.
For primary bibliographic entry see Field 5A.
W91-12450

TRIMETHYLPHENYLAMMONIUM-SMECTITE AS AN EFFECTIVE ADSORBENT OF WATER SOLUBLE AROMATIC HYDROCARBONS.
Michigan State Univ., East Lansing.
W. F. Jaynes, and S. A. Boyd.
Journal of the Air & Waste Management Association JAWAEB, Vol. 40, No. 12, p 1649-1653, December 1990. 3 fig, 1 tab, 13 ref. National Institute of Environmental Health Sciences Grant 1 P42 ES04911 01.

Descriptors: *Adsorption, *Clay liners, *Organoclays, *Smectite, *Waste disposal, *Water pollution control, Aromatic compounds, Clays, Hydrocarbons, Path of pollutants.

Homoionic trimethylphenylammonium (TMPA-) and tetramethylammonium (TMA)-clays were prepared by ion-exchange reactions using two smectite clays that differed in their cation exchange capacities and surface charge densities. These clays are referred to as a low-charge (SAC) and high-charge (SWa)-smectite. The organo-clays were evaluated as adsorbents of water soluble aromatic hydrocarbons including benzene, toluene, ethylbenzene, p-xylene, butylbenzene, and naphthalene. All of the aromatic hydrocarbons tested were effectively removed from water by the low-charge TMPA-smectite. The low-charge TMA-smectite was an effective adsorbent for benzene, but was ineffective in the removal of the alkylbenzenes and napthalene from water. The effect of surface charge on the adsorption properties of TMPA-smectite was reduced greatly compared to the low-charge TMPA-smectite. These results suggest the utility of TMPA-smectite as a liner material for petroleum storage containers and waste disposal reservoirs. The use of TMPA-smectite in conjunction with Na-smectite would provide a barrier with the ability to impede the flow of water and to effectively adsorb dissolved organic contaminants. (Author's abstract)
W91-12451

ENVIRONMENTAL CONSIDERATIONS FOR DESIGN OF THE ATHENS SEA OUTFALL, SARONIKOS GULF, GREECE.
Ministry of Environment, Planning and Public Works, 12 Varvaki Street, Athens (11474), Greece.
A. J. Theodorou, and C. Perissoratis.
Environmental Geology and Water Sciences EGWSEI, Vol. 17, No. 3, p 233-248, May/June 1991. 14 fig, 1 tab, 6 ref.

Descriptors: *Athens, *Environmental impact, *Greece, *Ocean dumping, *Saronikos Gulf, *Wastewater disposal, *Wastewater facilities, *Wastewater outfall, *Water pollution control, Sediments, Design criteria, Diffusers, Ocean circulation, Seismic exploration, Stratification, Stratigraphy, Surveys.

The pollution problems in Saronikos Gulf arise mainly from the discharge of about 600,000 cu m/day of untreated wastewater into the northern part of this gulf. To alleviate the situation, a new major treatment and sea disposal system is under construction. Its design included various physical oceanographic and marine geological surveys. During summer, the stratification at the site of discharge is sufficiently strong to prevent the submerged sewage field from surfacing. This strong summer stratification coupled with the virtual absence of upwelling and the presence of a well organized current field at the level of effluent trapping (about 40 m) ensures the offshore advection of the diluted submerged wastefield, via either the dominant cyclonic or the rarer anticyclonic circulatory patterns. The sea floor morphology is smooth (except near the Psyttalia coastline where poorly sorted coarse biogenic sands are steeply inclined), and the bottom is covered by an unconsolidated sedimentary layer with a thickness ranging from 10 to 167 cm and consisting in the western part of silty sand and in the eastern part of sandy silt. The seismic data indicated the absence of active faults, valleys, and channels. Below the surficial sediment cover, two seismic units were discerned, which may be correlated with the Quaternary and the Triassic outcrops on the island. The marine geological results indicated that rather minor technical work will be needed for the emplacement of the outfall system. (Author's abstract)
W91-12468

INFLUENCE OF PAPER MILL EFFLUENT IRRIGATION ON SOIL ENZYME ACTIVITIES.
Tamil Nadu Agricultural Univ., Coimbatore (India). Dept. of Agricultural Microbiology.
K. Kannan, and G. Oblisami.
Soil Biology & Biochemistry SBIOAH, Vol. 22, No. 7, p 923-926, 1990. 3 tab, 25 ref.

Descriptors: *Enzymes, *Land disposal, *Pulp and paper industry, *Soil chemistry, *Wastewater disposal, *Wastewater irrigation, Biogeochemistry, Organic matter, Soil bacteria, Soil fungi, Soil organisms, Waste disposal.

The practice of disposal of pulp and paper mill effluent onto the land adds large quantities of organic carbon and major essential elements to soils. In this study, it was noted that a number of such soils had high organic matter contents and increased microbial populations, which were directly proportional to the period of effluent irrigation. The application of effluent over a period of 15 years increased both the bacterial and the fungal populations in soil. There was an increase in amylase, phosphatase and dehydrogenase activities in these soils as the period of effluent irrigation increased. The activities of cellulase and invertase were greater in submerged soils than in garden soils to which effluent had been applied. (Author's abstract)
W91-12523

HEAVY METALS AND NUTRIENTS UPTAKE BY PLANTS AS AFFECTED BY THE APPLICATION OF ACID SLUDGE ON AN EGYPTIAN SANDY SOIL.
National Research Centre, Cairo (Egypt). Soils and Water Use Dept.
M. Abou Seeda, A. Khater, N. Salem, and S. Soliman.
Agrochimica AGRCAX, Vol. 34, No. 5/6, p 385-392, December 1990. 4 fig, 1 tab, 11 ref.

Descriptors: *Acid sludge, *Heavy metals, *Industrial wastes, *Land disposal, *Land treatment, *Nutrients, *Oil wastes, *Path of pollutants, *Plant growth, *Sludge disposal, *Sludge utilization, Aromatic hydrocarbons, Asphalt, Hydrocarbons, Hydrogen ion concentration, Nitrogen compounds, Plant tissues, Salinity, Sulfur compounds.

Acid sludge is a petroleum byproduct produced through the distillation of motor oil. The main constituents of acid sludge are paraffins, naphthenes, aromatic hydrocarbons and other compounds involving oxygen, nitrogen and sulfur as well as asphaltic and resinous compounds. A pot experiment was conducted with broad bean (Vicia faba) grown on a sandy soil treated with different rates of acid sludge in order to evaluate the effect of acid sludge on plant growth and the uptake of nutrients and heavy metals by plants. The applica-

tion of the acid sludge dramatically decreased both the pH and the growth of the plants. When the addition rate of the sludge was 5% of the soil (d.w./d.w.)no growth of plant was observed. Uptake of heavy metals by plants increased at high application doses of acid sludge especially for Zn, Mn, Cu, and Cd. The relation between dry matter and the concentration of heavy metals and nutrient elements in the plant tissue varied strongly with application rates of acid sludge. It was concluded: (1) the growth of the plants decreased with application of acid sludge; (2) the accumulation of heavy metals in plant tissue greatly increased with the application of acid sludge; (3) the acidity of the treated soil and the salinity increased when the acid sludge was incorporated into the soil; and (4) the safe use of acid sludge in sandy soil could be carried out only after getting rid of the excess heavy metals and neutralization of the acidity. (Agostine-PTT)
W91-12534

GROWTH OF PERENNIALS AND LEACHING OF HEAVY METALS IN MEDIA AMENDED WITH A MUNICIPAL LEAF, SEWAGE SLUDGE AND STREET SAND COMPOST.
Connecticut Agricultural Experiment Station, New Haven.
For primary bibliographic entry see Field 5B.
W91-12548

OPTIMUM ALLOCATION OF MONITORING WELLS AROUND A SOLID-WASTE LANDFILL SITE USING PRECURSOR INDICATORS AND FUZZY UTILITY FUNCTIONS.
Kyoto Univ. (Japan). Dept. of Environmental and Sanitary Engineering.
For primary bibliographic entry see Field 5A.
W91-12557

MODELING AND ANIMATION OF WASTEWATER DISPOSAL IN THE OCEAN ENVIRONMENT.
California Univ., Davis. Dept. of Civil Engineering.
A. E. Bale, and G. T. Orlob.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 179-185, 1991. 4 fig, 4 ref.

Descriptors: *Computer models, *Computer programs, *Model studies, *Ocean dumping, *Path of pollutants, *Wastewater disposal, *Wastewater outfall, *Water quality, Data processing, DisPath model, Dispersion, Graphical methods, Mass transport, Mathematical models, Simulation analysis, Waste disposal.

The discharge of municipal wastewater into the ocean environment results in a contamination of the seawater surrounding the outfall. The impacts of this wastewater discharge into the ocean are of concern to a diverse audience of regulatory agencies and citizens in coastal communities throughout the world. DisPatch, a graphically oriented, interactive computer program, has been designed to model the far-field transport of wastewater discharge in oceans. Implemented on a microcomputer, DisPatch features high-resolution graphics, menus, and dialogue boxes to facilitate user input of boundary conditions in such a way as to be accessible to a variety of potential users. The DisPatch model was developed from the application of the advection-dispersion equation to a horizontally homogeneous, vertically averaged, turbulent velocity field representing the ocean environment in which a patch of discharged wastewater is presumed to travel. Designed to accept either average values or a stochastically generated set of values for initial dilution and trapping height, DisPatch displays the path of each discharge event onscreen as an animation or calculated patch position and dimension. Results are presented in the form of an elevation view of contaminant impact at a user-defined impact zone. (See also W91-12568) (Korn-PTT)
W91-12590

LABORATORY INVESTIGATION OF RESIDUAL LIQUID ORGANICS FROM SPILLS, LEAKS, AND THE DISPOSAL OF HAZARDOUS WASTES IN GROUNDWATER.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
J. L. Wilson.
Available from National Technical Information Service, Springfield, VA 22161 as PB90-235797. Price codes: A13 in paper copy, A02 in microfiche. Environmental Protection Agency, Robert S. Kerr Environmental Research Laboratory, Ada, OK. Report EPA/600/6-90/004, April 1990. 267p, 127 fig, 24 tab, 161 ref, 4 append. State Project No. 1345648.

Descriptors: *Groundwater pollution, *Hazardous wastes, *Liquid wastes, *Organic compounds, *Wastewater disposal, Aquifer remediation, Path of pollutants, Porous media, Residual organic liquid wastes, Spatial distribution, Waste disposal.

Organic liquids that are essentially immiscible with water migrate through the subsurface under the influence of capillary, viscous, and buoyancy forces. These liquids originate from the improper disposal of hazardous wastes, and the spills and leaks of petroleum hydrocarbons and solvents. The laboratory studies described in this report examined this migration, with a primary focus on the behavior of the residual organic liquid saturation, referring to that portion of the organic liquid that is 'trapped' by capillary forces in the soil matrix. Residual organic saturation often constitutes the major volume of the organic liquid pollution, and acts as a continual source of dissolved or vapor phase organics. Four experimental methods were employed and results indicate that the spatial distribution and saturation of organic liquid within the porous media depends on a variety of factors, including: (1) the fluid properties of interfacial tension, viscosity, and density; (2) the soil structure and heterogeneity; (3) the number of fluid phases present; and (4) the fluid flow rates. Photomicrographs on a pore scale show that the residual organic liquid appears as blobs, films, rings and wedges of microscopic size, depending on these factors. The size, shape, and spatial distribution of these blobs, films, rings and wedges affects the dissolution of organic liquid into the water phase, volatilization into the air phase, and the adsorption and biodegradation of organic components. These four processes are of concern in the prediction of pollution migration and the design of aquifer remediation schemes. (Wilson-NM State U.)
W91-12630

EFFECTS OF MEDIUM COMPOSITION ON THE BACTERIAL LEACHING OF METALS FROM DIGESTED SLUDGE.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5D.
W91-12813

DEVELOPMENT OF ONE DIMENSIONAL WATER QUALITY MODEL FOR ORGANIC POLLUTANTS TRANSPORTED TO SEA FROM THE BLACK-STONE RIVER (IN CHINESE).
National Bureau of Oceanography, Xiamen (China). Third Inst. of Oceanography.
For primary bibliographic entry see Field 5B.
W91-12837

SLUDGE COMPOSTING ON A REGIONAL LEVEL.
North Carolina Dept. of Public Utilities, Hickory.
W. J. Twiggs.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 11-13, June 1991.

Descriptors: *Composting, *Sludge disposal, *Sludge utilization, Governmental interrelations, Local governments, North Carolina, Odor control, Regional development, Sludge dewatering, Waste disposal, Waste management, Wastewater facilities, Wastewater pretreatment.

Growing problems associated with land application of sludge prompted Catawba County N.C., and the cities of Hickory, Newton, and Conover to combine efforts to find a more suitable sludge management alternative. The county and local governments formed a regional sludge consortium and entered into a joint management agreement. The result is an 18 dry metric ton/d (20 dry ton/d) in-vessel sludge composting facility designed to meet the needs of each participating local government. The county and the three local governments jointly own the composting facility, with each participant's share of construction and operating costs based on its individual sludge volume. The city of Hickory is responsible for the facility's day-to-day operation, maintenance, and management, and has been operational since May, 1990. The primary operating units of the system are the: sludge receiving station, dewatering system, amendment system, compost reactors, control room, and odor control system. An on-site pretreatment system receives and pretreats water and filtrate from the dewatering process as well as condensate generated in the compost reactors. Following pretreatment, this wastewater travels by gravity sewer to Newton wastewater treatment plant located approximately 8 km (5 mi) from the compost facility. (Agostine-PTT)
W91-12874

5F. Water Treatment and Quality Alteration

MIXED WEAK ACID/BASE SYSTEMS, PART II: DOSING ESTIMATION, AQUEOUS PHASE.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
R. E. Loewenthal, M. C. Wentzel, G. A. Ekama, and G. R. Marais.
Water SA WASADV, Vol. 17, No. 2, p 107-122, April 1991. 3 fig, 3 tab, 7 ref.

Descriptors: *Acids, *Algorithms, *Bases, *Chemical properties, *Dose-response relationships, *Water analysis, *Water chemistry, *Water treatment, Estimations.

Algorithms were developed whereby the mass of dosing chemical could be estimated to bring about a desired change in the state of an aqueous mixture of weak acid/bases. It was shown that the solution alkalinity for an aqueous mixture of weak acid/bases (relative to a selected solution reference state defined by selected weak acid/base reference species) can be expressed as the sum of the subsystem alkalinities, one for each weak acid/base (relative to the same selected weak acid/base reference species) plus a water subsystem alkalinity (relative to H2O were the H(+) concentration = the OH(-) concentration = 0.0000001 moles/L). Making use of weak acid/base subsystem and water subsystem alkalinities, relatively simple dosing estimation algorithms were developed and applied to practical examples. It was found that the system was too cumbersome when applied to situations where more than one weak acid/base was present. The algorithms developed did lend themselves to any single mixture of weak acid/bases in solution and to computerized solution procedures. (White-Reimer-PTT)
W91-11766

NEW TRENDS IN INFECTIONS ASSOCIATED WITH SWIMMING-POOLS.
Pretoria Univ. (South Africa). Dept. of Medical Virology.
For primary bibliographic entry see Field 5C.
W91-11774

METHODOLOGY FOR LEAST-COST DESIGN OF INVULNERABLE WATER DISTRIBUTION NETWORKS.
Kentucky Univ., Lexington. Dept. of Civil Engineering.
V. Kessler, L. Ormsbec, and U. Shamir.
Civil Engineering Systems CESYEE, Vol. 7, No. 1, p 20-28, March 1990. 5 fig, 2 tab, 13 ref, 3 append.

Descriptors: *Cost-benefit analysis, *Design standards, *Hydraulic roughness, *Model studies, Algo-

rithms, Flow profiles, Mathematical models, Networks, Water conveyance, Water supply.

Water distribution networks, like other engineering systems, are subject to random failures. These failures may occur in the elements of the network (mostly pipes) or in the nodes (pipe junctions and demand nodes). Since a breakdown in water supply is not acceptable for more than a few hours, the network should be invulnerable to some extent; that is, it must include several independent alternatives of water supply to every consumer. Adopting an invulnerability degree of two alternative supplies, a new methodology is presented for the least-cost design of water distribution networks. According to this methodology the design process is controlled by the designer via three distinct stages. In the first stage, the alternative paths are allocated using graph theory algorithms. In the second stage, the minimum hydraulic capacity (diameters) of each path is determined using a linear programming model, and in the third stage the solution is tested by a network solver for various demand patterns. An example of the first stage and its relevant graph theory algorithms is included. (Author's abstract)
W91-11783

INVESTIGATION OF PATH REQUIREMENTS IN A WATER DISTRIBUTION NETWORK.
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
F. Bouchart, and I. Goulter.
Civil Engineering Systems CESYEE, Vol. 7, No. 3, p 127-134, September 1990. 9 fig, 1 tab, 14 ref.

Descriptors: *Design standards, *Mathematical models, *Model studies, *Networks, *Water conveyance, Conveyance structures, Pipelines, Water supply.

An optimization formulation for investigating and imposing minimum alternate flow path requirements in a water distribution network where the path requirements are taken as a measure of redundancy. In other words, the formulation is based upon achieving different levels of redundancy. The approach attempts to minimize the total number of links selected in a particular network while simultaneously minimizing the number of times a link is used to define paths from a source to any demand node in the network. The smaller the number of times a particular link is used in a path, the smaller the impact of its failure on network performance. Hence, the variation in network redundancy is given by this value (i.e., the number of times the link is used in a path) for each link to the network. The model can also be constrained to ensure that when two distinct paths are provided from a source to a node, the paths are completely independent, i.e., they have no common links. Links near the source tend to be used more frequently by all paths in the network, and are, therefore, more critical for the redundancy of the network. A priority ranking is used to place more emphasis on providing additional links in the network near the source, thereby, reducing the multiple use of these critical links. It is possible, theoretically, to develop trade-offs between the number of links in the network and the number of links in common to each demand node. However, unexplained computational difficulties with the optimization pack used to solve the integer programming formulation, prevented development of the trade-off function. Further work to modify the formulation, along the lines of those employed by other users of the package, may overcome this problem and make the model applicable to large and more realistic networks. (Lantz-PTT)
W91-11785

EPA EVALUATING BYPRODUCT RULE.
Hazen and Sawyer, Richmond, VA.
For primary bibliographic entry see Field 5G.
W91-11991

ENTROPY-BASED REDUNDANCY MEASURES IN WATER-DISTRIBUTION NETWORKS.
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-12053

MUTAGENICITY OF THE COMPONENTS OF OZONATED HUMIC SUBSTANCE.
Mie Univ. Hospital, Tsu (Japan).
For primary bibliographic entry see Field 5C.
W91-12150

MUTAGENICITY OF OZONATION AND CHLORINATION PRODUCTS FROM P-HYDROXYBENZALDEHYDE.
Mie Univ. Hospital, Tsu (Japan).
For primary bibliographic entry see Field 5C.
W91-12151

RELIABILITY-BASED DISTRIBUTION SYSTEM MAINTENANCE.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
R. G. Quimpo, and U. M. Shamsi.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 117, No. 3, p 321-339, May/June 1991. 10 fig, 2 tab, 34 ref. NSF Grant ECE-8601169.

Descriptors: *Decision making, *Maintenance, *Management planning, *Reliability, *Water distribution, Norwich, Pennsylvania, Priorities, Topology, Water demand.

A strategy was developed for prioritizing decisions for the maintenance of a water distribution system. Using component and network reliability based on time-varying connectivity concepts, the probabilities that water will be available at demand points in the system are calculated to determine a reliability surface. At any time this surface is used to locate low-reliability areas, which identify parts of the system needing maintenance priority. The specific components that must be repaired or replaced are determined using a component importance criterion that measures the overall effect of component maintenance on the system reliability. The procedure has been applied to one hypothetical and two real-life water distribution systems (Braddock Water Authority, Pennsylvania, and City of Norwich, New York). The use of component failure probabilities and the topology of the distribution network to develop a reliability surface can be a valuable aid in prioritizing a maintenance program. However, as currently structured, this method does not consider costs of maintenance or the social importance of the structures being served (hospital vs. swimming pool), which might cause different priorities to be assigned than those based solely on reliability. (Rochester-PTT)
W91-12204

ABWASSERREINIGUNG BIS ZUR REZYKLIERUNGSFAHIGKEIT DES WASSERS (WASTE WATER TREATMENT FOR RECYCLING QUALITY).
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Verfahrenstechnik.
For primary bibliographic entry see Field 5D.
W91-12261

RANDOMIZED TRIAL TO EVALUATE THE RISK OF GASTROINTESTINAL DISEASE DUE TO CONSUMPTION OF DRINKING WATER MEETING CURRENT MICROBIOLOGICAL STANDARDS.
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment, L. Richardson, J. Siemiatycki, R. Dewar, and M. Edwardes.
American Journal of Public Health AJHEAA, Vol. 81, No. 6, p 703-708, June 1991. 7 tab, 22 ref.

Descriptors: *Drinking water, *Public health, *Standards, *Surveys, *Water pollution effects, *Water quality, *Water treatment, Comparison studies, Filtration, Microbiological studies, Reverse osmosis, Water quality control.

This project directly and empirically measured the level of gastrointestinal (GI) illness related to the consumption of tapwater prepared from sewage contaminated surface waters and meeting current water quality criteria. A randomized intervention trial was carried out; 299 eligible households were supplied with domestic water filters (reverse osmosis) that eliminate microbial and chemical contaminants from their water, and 307 households were left with their usual tapwater without a filter. The GI symptomatology was evaluated by means of a family health diary maintained prospectively by all study families over a 15-month period. The estimated annual incidence of GI illness was 0.76 among tapwater drinkers compared with 0.50 among filtered water drinkers ($p < 0.01$). These findings were consistently observed in all population subgroups. It is estimated that 35% of the reported GI illnesses among the tapwater drinkers were water-related and preventable. (Author's abstract)
W91-12282

RISK ASSESSMENT AND CONTROL OF WATERBORNE GIARDIASIS.
University of South Florida, Tampa. Dept. of Environmental and Occupational Health.
J. B. Rose, C. N. Haas, and S. Regli.
American Journal of Public Health AJHEAA, Vol. 81, No. 6, p 709-713, June 1991. 1 fig, 4 tab, 19 ref, append.

Descriptors: *Drinking water, *Giardia, *Giardiasis, *Public health, *Risk assessment, *Water pollution effects, *Water quality control, *Water treatment, Model studies, Water quality.

Waterborne giardiasis has been increasing in the United States with 95 outbreaks reported over the last 25 years. The Safe Drinking Water Act has mandated control of this pathogen. A risk assessment model was developed to estimate the risk of infection after exposure to treated waters containing varying levels of Giardia cysts. The model was defined by a dose-response curve developed from human feeding studies for Giardia and assumed 2L of water consumption per day. Data on the concentration and distribution of the organism in source waters were used to assess exposure after varying reductions achieved through treatment. In surveys reporting prevalence and levels of Giardia cyst contamination, average levels of cysts in surface waters ranged from 0.33 to 104/100 L; from pristine watersheds (protected from all human activity) 0.6 to 5/100 L. Yearly risks were 0.0048 for systems using polluted waters and 0.0013 for pristine waters with a 0.001 treatment reduction. Public Health officials will need to work with the water industry to ensure a risk of $< 1/10{,}000$ for source waters with 0.7 to 70 cysts per 100 L through treatment achieving reduction of 0.001 to 0.00001, respectively, of Giardia cysts. (Author's abstract)
W91-12283

ENDEMIC GIARDIASIS AND MUNICIPAL WATER SUPPLY.
Otago Area Health Board, Dunedin (New Zealand). Public Health and Primary Care Programs.
G. G. Fraser, and K. R. Cooke.
American Journal of Public Health AJHEAA, Vol. 81, No. 6, p 760-7762, June 1991. 3 tab, 11 ref.

Descriptors: *Drinking water, *Giardiasis, *Municipal water, *New Zealand, *Water quality, Dunedin, Filtration, Public health, Water treatment.

To test the hypothesis that endemic giardiasis may be transmitted by unfiltered municipal water supplies, the incidence of laboratory-confirmed giardiasis was studied in a natural experiment due to the arrangement of the public water supply of Dunedin, New Zealand. The incidence rate ratio was 3.3 (90% CI = 1.11, 10.1) for the population receiving unfiltered (microstrained) water relative to that using sand filtered water. In a parallel case-control study of incident cases, the odds ratio for giardiasis and unfiltered (microstrained) water supply was 1.8 (90% CI = 0.5, 6.9). (Author's abstract)
W91-12284

MICROBIOLOGIC QUALITY OF DRINKING WATER IN NORTH CAROLINA MIGRANT LABOR CAMPS.
North Carolina Univ. at Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5G.
W91-12285

MAGNESIUM AND CALCIUM IN DRINKING WATER AND CARDIOVASCULAR MORTALITY.
Goeteborg Univ. (Sweden). Dept. of Environmental Hygiene.
R. Rylander, H. Bonevik, and E. Rubenowitz.
Scandinavian Journal of Work, Environment and Health SWEHDO, Vol. 17, No. 2, p 91-94, April 1991. 1 fig, 1 tab, 19 ref.

Descriptors: *Calcium, *Drinking water, *Magnesium, *Mortality, Cadmium, Hardness, Lead, Public health, Statistical analysis, Sweden, Water quality.

Data on the hardness of drinking water were collected from 27 municipalities in Sweden where the drinking water quality had remained unchanged for more than 20 years. Analyses were made of the levels of lead, cadmium, calcium, and magnesium. These water quality data were compared with the age-adjusted mortality rate from ischemic heart and cerebrovascular disease for the period 1969-1978. Lead and cadmium were not present in detectable amounts except in one water sample. A statistically significant inverse relationship was present between hardness and mortality from cardiovascular disease for both sexes. Mortality caused by ischemic heart disease was inversely related to the magnesium content, particularly for the men ($P < 0.01$). The rather small set of data supports results from previous studies suggesting that a high magnesium level in drinking water reduces the risk for death from ischemic heart disease, especially among men, although the possible importance of confounding factors needs further evaluation. (Author's abstract)
W91-12305

RELIABILITY IMPROVEMENT FOR WATER DISTRIBUTION NETWORKS THROUGH INCREASING PIPE SIZE.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Industrial Engineering and Management.
For primary bibliographic entry see Field 8B.
W91-12316

EVALUATION OF MUNICIPAL WATER SUPPLY OPERATING RULES USING STOCHASTIC DOMINANCE.
National Pingtung Inst. of Agriculture (Taiwan). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 6D.
W91-12327

SCREENING AS A METHOD FOR REMOVAL OF PARASITES FROM INLET WATER TO FISH FARMS.
Norsk Inst. for Vannforskning, Oslo.
H. Liltved, and B. R. Hansen.
Aquacultural Engineering AQENDG, Vol. 9, No. 3, p 209-215, 1990. 4 fig, 1 tab, 5 ref.

Descriptors: *Fish farming, *Parasites, *Screens, *Water treatment, Aquaculture, Filters, Larvae, Mortality, Water quality management.

A new screening system was designed and tested for the removal of particles and parasites from inlet and outlet water in fish farms. The screen system proved effective for the removal of parasitic larvae of the freshwater pearl mussel Margaritifera margaritifera. By screening the inlet water to the fish farm, the mortality caused by gill inflammation was eliminated. Experiments conducted at a plant in Sorkadelan, Norway, shows that screen systems have great potential for removing parasites from inlet water to fish farms. However, further research is needed to decide the mesh openings of the screens in proportion to the sizes of the various parasites and intermediate hosts. It is not yet clear what the improvement of the water quality through screening means for the ability of the parasites to multiply in the plant. Screening of the outlet water from fish farms can be an effective method to prevent spreading of parasites (for example, Gyrodactylus salaris) to river and lakes. (Lantz-PTT)
W91-12411

EFFECTS OF OZONATION ON MUTAGENIC ACTIVITY OF POLYCYCLIC AROMATIC HYDROCARBONS.
Lyon-1 Univ. (France). Dept. of Toxicology.
B. Fouillet, P. Chambon, R. Chambon, M. Castegnaro, and N. Weill.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 1-7, July 1991. 2 fig, 2 tab, 12 ref.

Descriptors: *Mutagens, *Ozonation, *Polycyclic aromatic hydrocarbons, *Water pollution effects, *Water treatment, Ames test, Bacteria, Bioassay, Chemical water treatment, Drinking water.

Polycyclic aromatic hydrocarbons (PAHs) represent a broad class of pollutants that are distributed widely in the environment. Four PAHs (benzo(a)pyrene (B(a)P), chrysene (CH), 7,12-dimethylbenzo(a)anthracene (DMBA), and 3-methylcholanthrene (MCA) in hexane were treated with ozone to determine the effectiveness of degradation and to evaluate the genetic properties of ozone byproducts. Partial and total ozonation were carried out. The disappearance of parent compounds and the appearance of ozone by products were measured by high-performance liquid chromatography (HPLC) coupled with spectrofluorimetry and UV spectrophotometry. A plate incorporation mutagenicity assay with a Salmonella typhimurium strain was used to test the ozone byproducts, with and without metabolic activation. DMBA ozone byproducts did not show mutagenic activity in the TA100 strain. Ozonation of CH and MCA showed weak mutagenic activity with metabolic activation. B(a)P byproducts showed direct mutagenic activity (43 revertants per microgram) immediately after either partial or total ozonation. This persisted (30 revertants per microgram) with metabolic activation. However, when the mutagenicity test was done a day later, no mutagenicity was observed. In all cases, the mutagenicity of byproducts arising from partial ozonation appears to be weaker than that of byproducts arising from total ozonation. (Rochester-PTT)
W91-12427

EFFECT OF AN ADDITION OF SODIUM SULFITE ON THE MUTAGENICITY OF CHLORINATED SOLUTIONS OF AQUATIC HUMIC SUBSTANCES.
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
C. Morlay, J. De Laat, M. Dore, Y. Courtois, and H. Houel.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 15-22, July 1991. 4 fig, 2 tab, 10 ref.

Descriptors: *Dechlorination, *Humic substances, *Mutagens, *Sodium sulfite, *Water treatment, Ames test, Chemical water treatment, Chlorinated hydrocarbons, Drinking water, Sulfites.

Recent studies have reported a decrease in the mutagenic activity and the total organic halogen content of chlorinated samples of drinking water and of solutions of humic substances that were dechlorinated with sulfur dioxide derivatives. A study was undertaken to gain a better understanding of the effects of dechlorination treatments with S(IV) species, especially sodium sulfite (Na2SO3) on the mutagenic activity of chlorinated drinking water. The experiments were conducted with aquatic humic substances (AHS) isolated from reservoir water by XAD-8 resin extraction. The effects of partial or complete dechlorination on the total organic chlorine level and mutagenicity (Salmonella typhimurium strains TA98 and TA100) were determined. The results obtained with chlorinated solutions of AHS show that a decrease in the mutagenic activity can be obtained under neutral conditions after sulfite addition. These results also indicate that a partial dechlorination with sulfite has no significant effect, either on the total organic chlorine level or on the mutagenicity of chlorinated samples of AHS. (Rochester-PTT)
W91-12428

SURVEY OF FARM WELLS FOR NUTRIENTS AND MINERALS, ONTARIO, CANADA, 1986 AND 1987.
Ontario Ministry of Agriculture and Food, Guelph. Agricultural Lab. Services Branch.
R. Frank, N. Chapman, and R. Johnson.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 47, No. 1, p 146-151, July 1991. 4 tab, 8 ref.

Descriptors: *Canada, *Groundwater chemistry, *Groundwater pollution, *Groundwater quality, *Minerals, *Nutrients, *Ontario, *Rural areas, *Wells, Calcium, Chlorides, Farms, Magnesium, Nitrates, Public health, Soil contamination, Sulfates, Surveys, Water supply.

Studies in both Canada and the United States have show varying degrees of nitrate contamination of rural well water. A study was conducted to determine (1) the extent of farm well contamination with plant nutrients, especially nitrate, and (2) the extent of contamination with naturally occurring salts, chlorides, and sulfates and the earth elements calcium and magnesium. In 1986 and 1987, 180 farm wells and 4 urban water supplies were sampled across southern Ontario. Samples were analyzed in 1986 for Cl, K, Mg, NO3, SO4, total salts, and pH; in 1987 NO3 was determined. Almost half the wells were located on clay type soils, 30% on sandy or gravel loams, and the rest on silt loams. Most of the wells (74%) were near the farm house or building and grassed. Maximum Desirable Concentrations (MDCs) have been established by the Ontario Ministry of Environment. No waters exceeded the MDC for Ca (500 mg/L) and only one exceeded the MDC for pH. Two readings over the MDC for sulfate were observed and chlorides exceeded the MDC of 250 mg/L in 15 wells. In 1986, 16 wells had NO3 concentrations above the Maximum Acceptable Concentration (10 mg/L) established by Health and Welfare Canada; most were on sandy loam soils located in corn-soybean growing areas. In 1987, five wells were above the 10 mg/L level; all were located on sandy loam soils, at the edges of fields and close to the farm buildings or home. Since the nitrate problem in confined to shallow or dug wells, it can be solved by taking drinking water from drilled wells. This would not resolve the high chloride levels, which were found mainly in drilled wells. (Rochester-PTT)
W91-12438

EUROPEAN DRINKING WATER STANDARDS.
Water Services Association, London (England).
M. Carney.
Journal of the American Water Works Association JAWWA5, Vol. 83, No. 6, p 48-55, June 1991. 1 tab, 17 ref.

Descriptors: *Drinking water, *European Economic Community, *Public health, *Standards, *Water pollution control, Economic aspects, Enforcement, Herbicides, Lead, Nitrates, Pesticides, Water chemistry, Water industry.

The main European Community (EC) directive on drinking water is the council directive 'Relating to the Quality of Water Intended for Human Consumption.' The main directive was agreed to by the EC Council of Ministers in 1978 and promulgated July 15, 1980. Three types of standards are used: (1) maximum admissible concentration; (2) minimum required concentration; and guide level. For most of the 66 requirements (parameters), the directive sets one or more of these standards. The parameters covered include: four organoleptic parameters (color, turbidity, odor, and taste); 15 physicochemical parameters (e.g., temperature, conductivity, and naturally occurring substances such as sodium or hydrogen); 24 substances undesirable in excessive amounts (e.g., nitrate, phenol,

and copper); 13 toxic substances (e.g., lead, cadmium, and pesticides); six microbiological parameters (e.g., fecal coliform); and four minimum requirements related to hardness and softness. Compliance problems of various kinds are occurring throughout the member states in the areas of MACs, nitrates, pesticides and herbicides, and lead. Continually rising standards are likely to lead to increased prices for water as suppliers need to employ more complex and expensive treatment steps. (Rochester-PTT)
W91-12453

MAIN FEATURES OF LARGE WATER TREATMENT PLANTS IN JAPAN.
Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA.
S. Kawamura, and R. R. Trussell.
Journal of the American Water Works Association JAWWA5, Vol. 83, No. 6, p 56-62, June 1991. 5 tab.

Descriptors: *Japan, *Water treatment facilities, Activated carbon, Computers, Construction costs, Control systems, Design criteria, Pilot plants, Polymers, Sludge treatment.

Japan, one of the most industrialized countries in the world has water treatment processes that have some unique features. Japan has a population of 120 million people heavily concentrated in larger urban areas. Seasonal typhoons and population density affect the requirements of water treatment. A survey of the features of several major systems in Japan (Tokyo, Chiba Prefecture, Osaka, Toyono, Osaka Prefecture, Murano, Kyoto, and Keage) demonstrated many of the unusual features of water purification in Japan. Japan's regulatory agencies prohibit use of synthetic high-molecular-weight organic polyelectrolytes of any kind for treatment of drinking water. The Japanese have fewer dust problems with powdered activated carbon (PAC) because they use a PAC product that is 50% moisture by weight. Baffled-channel filtration systems are often used in lieu of mechanical flocculation systems in newly built plants. There is extensive use of horizontal-flow clarifiers with a parallel-plate, high-rate settler module that accommodates horizontal flow. Filter presses are used extensively for dewatering alum sludge, in many cases without chemical pretreatment. Alum recovery from sludge was widely practice 20 yr ago, but today dried sludge often is disposed of in landfills or used as a soil conditioner. Elaborate computerized instrumentation and control systems use artificial intelligence to estimate chemical requirements. None of the plants visited employ pH control for corrosion control. Utilities are managed by boards appointed by the local governments. The utilities derive their income from the water rates they set. Construction costs in Japan appear to be higher than those in the United States. Several plants employ pilot facilities to evaluate various technical issues. (Rochester-PTT)
W91-12454

RESELLING AND VENDING WATER.
Tampere Univ. of Technology (Finland). Inst. of Water and Environmental Engineering.
T. S. Katko.
Journal of the American Water Works Association JAWWA5, Vol. 83, No. 6, p 63-69, June 1991. 4 fig, 5 tab, 29 ref.

Descriptors: *Developing countries, *Marketing, *Water conveyance, *Water costs, *Water distribution, Case studies, Economic aspects, Mozambique, Tanzania, Water supply development.

Until recently, the reselling and vending of water in the developing world has been largely ignored by utilities, governments, and external support agencies. Owners of private connections resell water to customers who come and fetch it. Vendors transport water door-to-door or sell it wholesale. Reselling and vending indicate consumers' ability and willingness to pay for water service. Recent examples and two case studies suggest that these practices can be used as design criteria for utility services, especially in peri-urban areas. For example, in 1988 the population of Morogor, Tanzania, was 120,000, but only 3,660 had private water connections. A total of 15 owners of courtyard taps were found to resell water at a price of 1 Tanzanian shilling per 20-L bucket to individuals and 2 Tanzanian shillings per bucket to vendors. An average family relying mainly on resold water and using 20 L per capita per day spent about 5% of its income on water. In a suburban area of Beira, Mozambique, households collected water from three main sources: resellers, public standposts, and open wells. Of the total amount of water consumed, 65% was purchased from open wells, 20% from resellers, and only 15% from public standposts. There are several examples of institutionalized water vending and reselling. In Kenya water kiosk operators take care of selling water as well as of controlling tap water wastage. Public standposts, which are supposed to be maintained by collecting small monthly taxes, have been converted to water vendor-operated systems. Water vending is costly solution to water distribution problems, but the vendors make little profit because of high transportation costs. Water resellers seem to make larger profits than vendors. By studying water reselling and vending, water utilities should be able to demonstrate the high cost of these practices for relatively poor service. Such studies probably would support the feasibility of piped systems. (Rochester-PTT)
W91-12455

ASSESSING PERLITE AS A SAND SUBSTITUTE IN FILTRATION.
Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.
S. S. Uluatam.
Journal of the American Water Works Association JAWWA5, Vol. 83, No. 6, p 70-71, June 1991. 3 tab, 8 ref. Scientific and Technical Research Council of Turkey Project DEBCAG 70.

Descriptors: *Filter media, *Filtration, *Perlite, *Turkey, *Water treatment, Economic aspects, Porosity, Sand, Sand filters, Suspended solids.

Quartz sand is used commonly in filter beds to remove suspended solids. In Turkey, however, sources of sand suitable for filtration are limited and costly, making it necessary for utilities to examine alternative bed materials. Crushed, raw perlite, which is plentiful along Turkey's Aegean coast, was examined for its suitability as a substitute for sand. Sieve analysis, porosity, particle density, and solubility in 20% HCl as well as costs of perlite versus sand were examined. When perlite and sand were placed in filter beds, the associated porosities were 45% and 39%, respectively. If the dominant filtration mechanism is sedimentation, the high porosity of perlite may provide a better filtrate. Perlite appears to be a more suitable filter material than sand based on its physical characteristics, but the effectiveness of crushed raw perlite in the purification of potable water and wastewater and the specific deposit characteristics of perlite filtration must be investigated under actual operating conditions. Initial results from a comparison filtration study appear to support perlite as a suitable filtration material that could be substituted for sand. (Rochester-PTT)
W91-12456

REVERSE OSMOSIS APPLICATIONS IN SAUDI ARABIA.
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 3A.
W91-12457

KINETICS OF MANGANESE AND IRON OXIDATION BY POTASSIUM PERMANGANATE AND CHLORINE DIOXIDE.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, J. E. Van Benschoten, M. J. Kearney, W. Soborski, and D. A. Reckhow.
Journal of the American Water Works Association JAWWA5, Vol. 83, No. 6, p 80-87, June 1991. 14 fig, 7 tab, 20 ref.

Descriptors: *Chemical water treatment, *Iron, *Kinetics, *Manganese, *Potassium permanganate, *Water treatment, Chlorine dioxide, Dissolved organic carbon, Hydrogen ion concentration, Oxidation, Temperature.

Although methodologies have been published for decades that relate to the control of soluble iron and manganese concentrations at water treatment facilities, modifications of water treatment practices make it necessary to reevaluate these methods. Research was conducted with the following aims: (1) to quantify the kinetics of Mn(II) and Fe(II) oxidation by potassium permanganate and chlorine dioxide; (2) to illustrate the effects of reduced metal ion concentration, pH, temperature, and the presence of dissolved organic carbon (DOC) on these kinetics; and (3) to analyze aspects of oxidation using modeling. These studies led to several conclusions, including: oxidation of reduced Mn(II) was rapid except at low solution temperatures; rates of Mn(II) oxidation are acceptable in the presence of humic and fulvic acids, but those acids strongly inhibit Fe(II) oxidation efficiency; and poor manganese removal may be caused by inefficient capture of MnOx(s). The sequence in which oxidants are added may be an issue in the design and operation of water treatment plants. (Author's abstract)
W91-12458

EVALUATING THE PERFORMANCE OF TWO PLASTIC PACKINGS IN A CROSSFLOW AERATION TOWER.
California Univ., Berkeley.
J. C. Little, and R. E. Selleck.
Journal of the American Water Works Association JAWWA5, Vol. 83, No. 6, p 88-95, June 1991. 12 fig, 4 tab, 24 ref.

Descriptors: *Air stripping, *Crossflow aeration towers, *Plastic packings, *Wastewater treatment, *Water treatment, Correlation analysis, Gases, Liquids, Mathematical equations, Performance evaluation.

A crossflow air-stripping tower may be more economical than a counterflow tower for large air-to-water volumetric flow ratios because the distance of air travel is less with a crossflow configuration. However, any cost advantage is contingent on the packing providing the same performance in crossflow as in counterflow. The gas and liquid resistances to mass transfer were determined for two polypropylene packings placed in an experimental crossflow tower. The results then were compared with several counterflow mass transfer correlation equations. The liquid-side mass transfer properties of the two packings proved to be nearly identical for both types of operation, whereas Onda's counterflow gas-side equation failed to yield accurate results with either mode of operation or packing type. Crossflow air pressure drop gradients also were evaluated, with conflicting results. (Author's abstract)
W91-12459

MECHANISTIC STUDY OF OZONE-INDUCED PARTICLE DESTABILIZATION.
Montgomery (James M.), Inc., Walnut Creek, CA.
M. Edwards, and M. M. Benjamin.
Journal of the American Water Works Association JAWWA5, Vol. 83, No. 6, p 96-105, June 1991. 9 fig, 5 tab, 23 ref.

Descriptors: *Chemical reactions, *Coagulation, *Ozonation, *Particulate matter, *Water treatment, Carbonates, Hydrogen ion concentration, Organic matter.

Over the past 15 yr, there have been frequent claims that ozonation can improve the removal of particles during water treatment. Several hypotheses have been proposed to explain how this could happen. Studies were conducted to identify and evaluate various mechanisms by which ozone could affect the interactions of particles, natural organic matter (NOM), and coagulant. The effect of ozonation on particle behavior was investigated under a variety of conditions. Spontaneous particle coagulation (particle agglomeration without coagulant addition) lowered coagulant requirements

and formation of new particles was observed in some cases. In most instances, the observed changes could be induced by changing solution pH and carbonate concentration via strictly inorganic reactions, which did not require the presence of ozone. In the future, greater attention should be paid to changes in the inorganic composition of water accompanying ozonation and to the possible influence of these changes on the system behavior. (Author's abstract)
W91-12460

CHILDHOOD CANCER MORTALITY AND RADON CONCENTRATION IN DRINKING WATER IN NORTH CAROLINA.
National Inst. of Environmental Health Sciences, Research Triangle Park, NC. Epidemiology Branch.
For primary bibliographic entry see Field 5C.
W91-12546

MANAGEMENT OF A COMPLEX WATER SUPPLY NETWORK FOR THE STABILIZATION OF AQUATIC HABITAT.
For primary bibliographic entry see Field 5G.
W91-12582

ASPECTS OF INTELLIGENT TUTORING SYSTEMS APPLIED TO SMALL WATER TREATMENT PLANT EXPERT SYSTEMS.
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
A. G. Collins, J. Searleman, and K. J. Collins.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 307-314, 1991. 4 fig, 12 ref.

Descriptors: *Artificial intelligence, *Computer programs, *Data interpretation, *Expert systems, *Training, *Water treatment, Education, Intelligent tutoring system, Jar test, Process control.

An expert system has been developed to aid the operators of small water treatment plants. An Intelligent Tutoring System (ITS) is a component of the expert system which explains the possible reasons for common problems by focusing on the jar test analysis for chemical dosage control. The tutor provides the operator with an opportunity to run a jar test, receive feedback on the parameters selected, visualize the results on the actual water treatment processes, and be tutored in the topics related to understanding the processes involved and additional supplemental areas (such as concentrations and conversions). The jar test for chemical dose determination proved to be well defined and therefore a good candidate for ITS. The hierarchical structure for topics to be taught was a successful approach to represent information as was dividing the information to be taught into facts, simple skills, complex skills and concepts. The development of the tutor continues to be an ongoing process as more information is collected about how knowledge is acquired in this particular domain. (See also W91-12568) (Korn-PTT)
W91-12605

EXPERIENCE IN OPERATING THE WATER-COOLING SYSTEMS OF THE GENERATOR STATOR WINDINGS AT THE INGURI HYDROELECTRIC STATION.
For primary bibliographic entry see Field 8C.
W91-12618

WATER AND WASTEWATER FILTRATION: A PARTICLE PERSPECTIVE.
Texas Univ. at Austin. Dept. of Civil Engineering.
D. F. Lawler, J. L. Darby, T. P. Wilshusen, S. I. Koolik, and R. S. Cushing.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-195784. Price codes: A11 in paper copy, A02 in microfiche. Center for Research in Water Resources Austin, Texas, Final Report, 1991. 236p, 101 fig, 19 tab, 71 ref. USGS Contract No. 14-08-0001-G1502.

Descriptors: *Filters, *Filtration, *Particle size, *Wastewater treatment, *Water purification, *Water treatment, Experimental models, Mathematical models, Particle size distributions, Porous media, Separation techniques.

Depth filtration removes particles by attaching them to the media or to previously-retained particles. Because of the latter, filters improve their efficiency over time, a process known as ripening. The research objectives were to: (1) determine experimentally changes in particle size distribution and development of head loss in a filter bed over time and depth under varying physical conditions; and (2) compare the experimental observations to predictions from mathematical models of filtration performance. Laboratory experiments were performed with four different types of suspensions: (1) latex particles (mondodisperse, bi-modal, and tri-modal suspensions); (2) effluent from a secondary wastewater treatment plant; (3) water from a point in drinking water plant after sedimentation but before filtration; and (4) lake water from a drinking water source. The latter three types emulated the common uses of filtration in wastewater and drinking water treatment. Ripening was observed in virtually all experiments, and was particularly dramatic for particles in the range of approximately 1 microm. Favorable surface chemical conditions between particles and media and between particles in suspension and previously-retained particles are essential for ripening. Floc break-off was irrefutably evident in the latex experiments and is the only apparently reasonable explanation for some results of other experiments. The surface area of the captured particles is the principal determinant of the increase in head loss. Mathematical models are well-developed for clean bed conditions; theoretical models developed for ideal conditions predict well the initial removal for real suspensions like those tested from the treatment plants and lake. Significant improvements in the models are needed to account for the complex behavior of particles in filters, including the potential movement of particles around the surface of the media after being captured. (USGS)
W91-12625

RISK MANAGEMENT FOR NITRATE-CONTAMINATED GROUNDWATER SUPPLIES.
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-12634

CHEMICAL DOSING OF SMALL WATER UTILITIES USING REGRESSION ANALYSIS.
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
G. W. Ellis, A. G. Collins, and C. R. Ford.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 117, No. 3, p 308-319, May/June 1991. 4 fig, 3 tab, 15 ref, append.

Descriptors: *Chemical treatment, *Data interpretation, *Model studies, *Regression analysis, *Water treatment, Coagulants, Statistical models, Suspended solids, Turbidity, Water management, Water treatment facilities.

Water treatment databases can be used to formulate statistical models that have the potential to aid water plant operators, in particular those at small water utilities. A study using alum and prelime dosing showed that chemical doses can be predicted with confidence limits by developing regression relationships between the dosages and the physical parameters using multivariate linear regression models. Modeling the data sets from plants facing various treatment conditions allows the variability of these relationships to be studied. The final result could be included in an expert advisory system as an alternative to other heuristic, deterministic, or experimental dosage determination procedures. Because treatment operation will be based on statistical models of previous treatment decisions, plant efficiency can be maximized and treatment costs lowered. Improved methods for calculating treatment dosages will result in fewer plant upsets and more consistent water quality. Although the streaming current detector has been shown to be an effective tool for determining and controlling coagulant feed rates, under certain influent conditions the regression approach may, at times, be more appropriate. When influent turbidity is low or the level of suspended solids is high, determining chemical dosages using regression analysis may be a useful approach. (Lantz-PTT)
W91-12820

LIMESTONE CONTACTORS: STEADY-STATE DESIGN RELATIONSHIPS.
Syracuse Univ., NY. Dept. of Civil and Environmental Engineering.
R. D. Letterman, M. Hadad, and C. T. Driscoll.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 117, No. 3, p 339-358, May/June 1991. 8 fig, 3 tab, 25 ref, append. EPA Cooperative Agreement CR-809979-01-3.

Descriptors: *Contactors, *Limestone, *Model studies, *Water quality, *Water treatment, Alkalinity, Calcium carbonate, Hydrogen ion concentration, Porosity, Water chemistry, Water distribution, Water temperature.

Limestone contactors can mitigate corrosion in small water supply systems that use dilute, acidic water. As water is transported through a packed bed of crushed limestone, CaCO3 dissolves and the pH, calcium-ion concentration, and alkalinity increase. Operation of a contactor can be effectively modeled by considering the rate of dissolution and interfacial transport of calcium ions. The steady-state model developed and tested in this study relates the depth of limestone required in the contactor to the desired effluent water chemistry, influent water chemistry, limestone-article size and shape, bed porosity, water temperature, and superficial velocity. The magnitude of the rate constant that describes the release of calcium ions from the calcite surface varies with the pH at the particle surface. When this pH is < 9.5, the rate constant for the surface reaction becomes large, and the rate of dissolution tends to be controlled solely by the transport of calcium ions away from the interface. (Author's abstract)
W91-12822

KINETICS OF MANGANESE(II) OXIDATION WITH CHLORINE.
Maryland Univ., College Park. Dept. of Civil Engineering.
O. J. Hao, A. P. Davis, and P. H. Chang.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 117, No. 3, p 359-374, May/June 1991. 9 fig, 3 tab, 28 ref, append.

Descriptors: *Chemical reactions, *Chlorine, *Kinetics, *Manganese, *Oxidation, *Water treatment, Chemical treatment, Chlorination, Hydrogen ion concentration, Model studies.

The rate of Mn(II) oxidation by chlorine depends on pH and most importantly the chlorine dosage. Mn(II) oxidation is facilitated by excess chlorine at pH = 8. An autocatalytic model analogous to that for Mn(II) oxidation by O2 was developed in which the major mechanism for Mn(II) removal is heterogeneous Mn(II) adsorption onto newly precipitated MnO2. The same model also describes the effects of pH and the external addition of MnO2 on Mn(II) removal. Mn(II) oxygenation in the presence of equimolar ligand indicated the following: complete inhibition in the Mn-ethylenediaminetetraacetic acid (Mn-EDTA) system, moderate inhibition in the Mn-iminodiacetic acid (Mn-IDA) system, and slight inhibition in the Mn-glycine (Mn-GLY) system. The degree of inhibition, similar to that previously found for Fe(II) oxidation, follows the Mn-ligand complex affinity. However, Mn(II) removal in these systems occurs differently with chlorine as the oxidizing agent. Mn-EDTA accelerates the reaction while both Mn-IDA and Mn-GLY retards the reaction. (Author's abstract)
W91-12823

EFFECTS OF CHLORINATION OF ALGOGENIC ORGANIC MATTER ON FLOCCULATION.
Chinese Academy of Environmental Sciences, Beijing.

Z. Liu, and H. Bernhardt.
Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 24, No. 2, p 70-75, April 1991. 6 fig, 3 tab, 15 ref.

Descriptors: *Chlorination, *Drinking water, *Flocculation, *Organic matter, *Water treatment, Chemical reactions, Chemical treatment, Chlorine, Disinfection, Filtration, Halogens.

Several studies have shown that extracellular organic matter (EOM) existing in eutrophic surface water has an influence on the process of flocculation in water treatment. EOM reacts with chlorine added in water disinfection causing considerable chlorine consumption. Several types of EOM occurring in eutrophic lake water, as well as sodium alginate, a model substance, were chlorinated prior to flocculation. In all cases, chlorination products of EOM were found to reduce the impairment of flocculation. The formation of haloform and adsorbable organic halogens (AOX) resulting from the chlorination of EOM-containing water, was also investigated. Having observed both a decrease in the disturbance of EOM to flocculation and an increase in the polymer acidities of these substances after chlorination, reaction mechanisms can be inferred. EOM can be classified as a polysaccharide macromolecule which contains OH and COOH functional groups. These substances are broken down into smaller macromolecule parts during the first step of chlorination. At the same time, the number of their OH-groups and the molecular weight is reduced. This process is what decreases the flocculation disturbance. In the second step, a formation of AOX and haloforms is plausible. (Author's abstract)
W91-12864

NEW METHOD FOR MEASURING THE HARDNESS OF WATER.
Humboldt-Univ. zu Berlin (German D.R.). Fachbereich Chemie der.
For primary bibliographic entry see Field 2K.
W91-12865

ADSORPTION EQUILIBRIUM STUDIES OF SOME AQUEOUS AROMATIC POLLUTANTS ON GRANULAR ACTIVATED CARBON SAMPLES.
Laxminarayan Inst. of Tech., Nagpur (India).
M. K. N. Yenkie, and G. S. Natarajan.
Separation Science and Technology SSTEDS, Vol. 26, No. 5, p 661-674, May 1991. 6 fig, 3 tab, 6 ref.

Descriptors: *Activated carbon, *Adsorption, *Aromatic compounds, *Granular activated carbon, *Water treatment, Benzoic acid, Chemical analysis, Chemical properties, Cresol, Dyes, Organic compounds, Phenols.

Adsorption equilibrium studies of some aromatic organic pollutants in water, with some commercially available standard grades of granular activated carbons (GACs), have been carried out at 35 C. The adsorption equilibrium data for adsorbates such as phenol, aniline, benzoic acid, o-cresol, and p-methoxyphenol on six grades of granular activated carbons were analyzed for their adherence to Freundlich or Langmuir adsorption isotherms, and the results are discussed. In terms of relative adsorption trends in practically all GAC samples, the increase of adsorption follows the trend: aniline < phenol < benzoic acid < p-methoxyphenol < o-cresol at lower values of equilibrium concentration, while for higher equilibrium concentration values the benzoic acid interchanges its position with p-methoxyphenol and o-cresol in some systems. The alkyl-substituted phenols are more strongly adsorbed as compared to phenol itself, and adsorption increases as the length of the alkyl chain increases, explaining the larger extent of adsorption of o-cresol in spite of its high solubility and p-methoxyphenol may also be because it can effectively desorb phenol from the adsorbent surface, indicating preferential adsorption of p-methoxyphenol compared to phenol. Previous investigations indicated that adsorption of phenol from dilute aqueous solutions by carbon black was enhanced considerably when an acidic CO2-surface complex was eliminated and the CO-complex predominated. As phenol is slightly acidic in nature, the acidic surface complex may reduce the adsorption of phenol and increase the adsorption of aniline, which is basic in character. Since the extent of adsorption of aniline and phenol is nearly the same, as observed from the adsorption isotherms, it may be said that the acidic surface oxides are absent on the surface of the adsorbents used in this study. (Lantz-PTT)
W91-12899

RATE CONSTANTS FOR DIRECT REACTIONS OF OZONE WITH SEVERAL DRINKING WATER CONTAMINANTS.
SRI International, Menlo Park, CA. Chemistry Lab.
C. C. D. Yao, and W. R. Haag.
Water Research WATRAG, Vol. 25, No. 7, p 761-773, July 1991. 5 fig, 3 tab, 25 ref. EPA Contract CR-815215-01-0.

Descriptors: *Chemical reactions, *Drinking water, *Ozonation, *Ozone, Alachlor, Aldicarb, Alkanes, Aromatic compounds, Atrazine, Carbofuran, Esters, Halogenated organic compounds, Hydrogen ion concentration, Organic compounds, Pesticides, Solvents.

Rate constants for the direct reactions of ozone with 45 potential organic drinking water contaminants, including solvents, haloalkanes, esters, aromatics and pesticides (such as alachlor, aldicarb, atrazine, carbofuran, 2,4-dichlorophenoxyacetic acid, endrin, glyphosphate, etc), have been measured in water in the presence of hydroxyl radical scavengers to minimize interfering radical chain reactions. The data demonstrate, again, the electrophilic nature of the ozonation reaction. In addition, for complex molecules, steric factors are important in limiting reactivity. The zwitterionic compound glyphosate exhibits a complex pH dependence that is explained by the inductive effect of side-chain protonation on the basicity of the amine reaction center. Rate constants for ozone consumption differ from those for compound consumption by an amount presumably equal to the reaction stoichiometry. (Author's abstract)
W91-12905

TRIHALOMETHANE FORMATION IN CHLORINATED DRINKING WATER: A KINETIC MODEL.
Hebrew Univ. of Jerusalem (Israel). Graduate School of Applie Science and Technology.
A. Adin, J. Katzhendler, D. Alkaslassy, and C. Rav-Acha.
Water Research WATRAG, Vol. 25, No. 7, p 797-805, July 1991. 11 fig, 2 tab, 25 ref, append.

Descriptors: *Drinking water, *Model studies, *Trihalomethanes, *Water treatment, Chemical reactions, Chlorination, Disinfection, Fulvic acids, Humic acids, Kinetics, Temperature, Water quality.

Aquatic humic and fulvic acids are the main trihalomethane (THM) precursors formed during surface water chlorination. The plot of THM concentration against humic substance levels is a 'convex-'shape, suggesting that a multi-step reaction occurs. In the first step, organochlorine intermediates are produced, and, in the second step, these are converted to THM. A mechanistic model, based on the reaction of chlorine with model compounds, was used to derive kinetic equations for THM formation as a function of both precursor and chlorine concentrations under controlled pH and temperature conditions. Although the model in its present form has several limitations, combined with batch tests of any given water supply, it should allow: (1) determination of total organic carbon levels and the chlorination dose that can tolerated in order to meet the total THM standards; and (2) evaluation of the effectiveness of water treatment devices directed toward reducing THM levels. (Lantz-PTT)
W91-12909

PHOTODEGRADATION OF CHLOROFORM AND UREA USING AG-LOADED TITANIUM DIOXIDE AS CATALYST.
Universidade Estadual de Campinas (Brazil). Inst. de Quimica.
M. M. Kondo, and W. F. Jardim.
Water Research WATRAG, Vol. 25, No. 7, p 823-827, July 1991. 5 fig, 1 tab, 26 ref.

Descriptors: *Catalysis, *Chloroform, *Photolysis, *Titanium dioxide, *Ureas, *Water treatment, Chemical treatment, Irradiation, Water quality.

The photodegradation of chloroform and urea in aqueous solutions was investigated under near-UV and visible radiation using the anatase form of TiO2 as catalyst. It was shown that the catalytic activity of the TiO2 can be increased by loading silver, in a proportion of 1% (w/w), onto the oxide surface. In a solution containing 200 mg/L of chloroform, the photodegradation achieved using the Ag-loaded oxide was 44% compared to the 35% obtained using the pure (unloaded) oxide. This photoactivity was further enhanced in a solution containing 25 mg/L of chloroform. Upon reuse, a decrease in the photocatalytic activity was observed in both oxides, but to a lesser extent in the Ag-loaded TiO2. An increase in the photocatalytic activity of the silver-loaded oxide was also noted in the degradation of a 100 mg/L aqueous solution of urea. After 12 min. of irradiation, the Ag-loaded oxide destroyed 83% of this compound, compared to a 16% efficiency obtained for the pure form of anatase. After 6 hr of irradiation, 0.5 mg/L of silver ions were detected in the Ag-loaded TiO2 suspension. (Author's abstract)
W91-12912

5G. Water Quality Control

ECONOMIC FEASIBILITY OF AGRICULTURAL MANAGEMENT PRACTICES FOR REDUCING SEDIMENTATION IN A WATER SUPPLY LAKE.
Missouri Univ.-Columbia. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4D.
W91-11612

IMPACT TARGETS VERSUS DISCHARGE STANDARDS IN AGRICULTURAL POLLUTION MANAGEMENT.
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden, R. S. Larson, and E. E. Herricks.
American Journal of Agricultural Economics AJAEBA, Vol. 73, No. 2, p 388-397, May 1991. 5 fig, 2 tab, 23 ref.

Descriptors: *Aquatic habitats, *Economic evaluation, *Environmental policy, *Fish, *Model studies, *Nonpoint pollution sources, *Water pollution control, Agricultural chemicals, Lake Michigan, Pesticides, Sediment control, Water quality management.

The economic losses from the use of soil movement rather than water quality criteria for the attainment of habitat protection for high-valued fish species were examined using a version of the Sediment Economics (SEDEC) model. The SEDEC model was extended to include: (1) seasonality of sediment loads; (2) pesticide losses, toxicity, and concentrations; and (3) effects of sediment and pesticides on the habitat requirements of selected fish species. Estimates were based on a case study of Lake Michigan tributaries. The study showed that when attempting to protect fish in streams, sediment or erosion targets are inefficient. Use of a habitat suitability target reveals lower cost abatement measures because it accounts for pesticides as well as soil particles. In the Lake Michigan case studies the lower cost measures involve more crop diversity, less use of no-till, and changes on more acres than the solutions based on sediment discharges or erosion rates. (Author's abstract)
W91-11614

DETRITUS AND THE CONCEPT OF NON-PREDATORY LOSS.
Vienna Univ. (Austria). Inst. fuer Allgemeine Biologie.
For primary bibliographic entry see Field 2H.
W91-11615

REVIEW OF SOME CHARACTERISTICS OF FRESHWATER AND COASTAL ECOSYSTEMS IN GHANA.
Institute of Aquatic Biology, Achimota (Ghana).
For primary bibliographic entry see Field 2L.
W91-11625

RESPONSES OF A EUTROPHIC POND COMMUNITY TO SEPARATE AND COMBINED EFFECTS OF N:P SUPPLY AND PLANKTIVOROUS FISH: A MESOCOSM EXPERIMENT.
Texas Christian Univ., Fort Worth. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W91-11634

ESTABLISHING BIOSPHERE RESERVES FOR COASTAL BARRIER ECOSYSTEMS.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2L.
W91-11643

LONG-TERM RESEARCH AT THE VIRGINIA COAST RESERVE.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2L.
W91-11644

RISKS OF CONSUMPTION OF CONTAMINATED SEAFOOD: THE QUINCY BAY CASE STUDY.
Metcalf and Eddy, Inc., Wakefield, MA.
For primary bibliographic entry see Field 5C.
W91-11677

GWALTNEY OF SMITHFIELD V. CHESAPEAKE BAY FOUNDATION: A NEW FORM OF SUBJECT MATTER JURISDICTION UNDER SECTION 505 OF THE CLEAN WATER ACT.
For primary bibliographic entry see Field 6E.
W91-11681

NUTRIENT DYNAMICS AND PELAGIC FOOD WEB INTERACTIONS IN OLIGOTROPHIC AND EUTROPHIC ENVIRONMENTS: AN OVERVIEW.
Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.
J. Capblanq.
Hydrobiologia HYDRB8, Vol. 207, p 1-14, November 22, 1990. 5 fig, 88 ref.

Descriptors: *Food chains, *Lake ecology, *Limiting nutrients, *Marine environment, *Nitrogen, *Phosphorus, *Phytoplankton, *Water pollution control, Algal growth, Bacteria, Carbon cycle, Comparison studies, Cycling nutrients, Ecosystems, Eutrophy, Nutrient concentrations, Oligotrophy, Plankton, Surface water.

The concept of limiting nutrients is a cornerstone of theories concerning the control of production, structure and dynamics of freshwater and marine plankton. The current dogma is that nitrogen is limiting in most marine environments while freshwater ecosystems are mostly phosphorus-limited, although evidence of phytoplankton limitation by either nitrogen or phosphorus has been found in both environments. However, the same considerations apply to the availability of phosphorus in freshwater as to nitrogen in oceans. In resource-limited environments the plankton dynamics depend mostly on the internal mechanisms which act to recycle the limiting nutrient many times over within the surface waters. As the overall productivity increases, this dependence on nutrient regeneration decreases. The relationship between the stock of limiting nutrient, rates of supply and plankton dynamics must therefore be seen in the light of the processes operating within the entire food chain over quite different time scales. Process-rates are mostly size-dependent and food web interactions at the microbial level (picophytoplankton, bacteria, microheterotrophs) strongly affect the production of carbon and the regeneration of nutrients in the pelagic zone. Little evidence exists for nutrient-limited growth rates of planktonic algae even in the more oligotrophic areas, where carbon-14 based estimates of primary production have been suspected of grossly underestimating actual production. Given the importance of size-structured interactions in planktonic food-webs, the development of other bases for species aggregation than traditional taxons or trophic levels should be encouraged in both theoretical and experimental study of pelagic ecosystems. (Brunone-PTT)
W91-11683

EFFECTS OF OXYGEN ON DENITRIFICATION IN MARINE SEDIMENTS.
Centre d'Oceanologie de Marseille (France).
For primary bibliographic entry see Field 2L.
W91-11694

SELECTION OF METHODS FOR THE DETECTION AND ESTIMATION OF TRENDS IN WATER QUALITY.
Geological Survey, Reston, VA.
R. M. Hirsch, R. B. Alexander, and R. A. Smith.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 803-813, May 1991. 12 fig, 5 tab, 22 ref.

Descriptors: *Data interpretation, *Monitoring, *Statistical methods, *Water quality trends, Estimating equations, Mathematical analysis, Planning, Seasonal variation, Streamflow, Water quality, Water quality data.

One result of increased scientific and public interest in water quality over the past few decades has been the gradual accumulation of reliable long-term water quality data records and an interest in examining these data for long-term trends. There are a number of major issues and choices that must be considered in detecting and estimating the magnitude of temporal trends in measures of stream water quality. The first issue is the type of trend hypothesis to examine: step trends versus monotonic trend. The second relates to the general category of statistical methods to employ: parametric versus nonparametric. The third issue relates to the kind of data to analyze: concentration data versus flux data. The fourth relates to issues of data manipulation to achieve the best results from the trend analysis. These issues include the use of mathematical transformations of the data and the removal of sources of variability in water quality due to seasonal and stream discharge variations. The final issue relates to the choice of a trend technique for the analysis of data records with censored or 'less than' values. Various statistical tests and estimators, along with the use of exploratory data analysis procedures, are of use in providing insights about water quality trends at a given site and about water quality trends over entire regions. (Author's abstract)
W91-11734

TAKING ADVANTAGE OF STORMWATER CONTROL BASINS IN URBAN LANDSCAPES.
Georgia Univ., Athens. School of Environmental Design.
For primary bibliographic entry see Field 4A.
W91-11750

REANALYSIS OF DATA SUPPORTING U.S. FEDERAL BACTERIOLOGICAL WATER QUALITY CRITERIA GOVERNING MARINE RECREATIONAL WATERS.
J. M. Fleisher.
Research Journal of the Water Pollution Control Federation RJWFE7, Vol. 63, No. 3, p 259-265, May/June 1991. 3 fig, 5 tab, 15 ref.

Descriptors: *Data interpretation, *Epidemiology, *Swimming, *Water quality criteria, Gastroenteritis, Marine environment, Pathogenic bacteria, Public health, Public waters, Recreation, Regression analysis, Water pollution effects.

Current U.S. federal bacteriological water quality criteria governing marine recreational waters are based solely on a mathematical relationship between enterococci density and gastroenteritis among swimmers reported in a large prospective epidemiological study conducted for EPA. However, this epidemiological study contained serious methodological and analytical weaknesses. These weaknesses have been identified and the data have been reanalyzed. The reanalysis used logistic regression modeling to estimate the probability of gastroenteritis occurring in the individual swimmer at different enterococci densities. The results of this reanalysis show that the mathematical relationship between enterococci density and swimming-associated gastroenteritis derived by the EPA study to be of questionable validity. Therefore, current federal bacteriological water quality criteria governing marine recreational waters are not based on strong enough evidence to support their continued use. (Author's abstract)
W91-11762

INVESTIGATION OF PATH REQUIREMENTS IN A WATER DISTRIBUTION NETWORK.
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-11785

DOMESTIC WASTEWATER MANAGEMENT ALTERNATIVES FOR THE MT LOFTY RANGES WATERSHED.
South Australian Dept. of Engineering and Water Supply, Adelaide.
For primary bibliographic entry see Field 5D.
W91-11808

PROMISING TECHNOLOGIES FOR THE BIOLOGICAL DETOXIFICATION OF HAZARDOUS WASTE.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
J. A. Glaser.
IN: Alternative Waste Treatment Systems. Elsevier Science Publishing Co., New York. 1988. p 108-117, 27 ref.

Descriptors: *Biodegradation, *Bioremediation, *Cleanup, *Fungi, *Hazardous waste treatment, *Soil contamination, *Soil treatment, *Wastewater treatment, *Water pollution treatment, *Wood wastes, Aromatic compounds, Biological studies, Creosote, Lignin, Nitrogen, Pentachlorophenol, Soil fungi.

A number of new biological technologies that target the cleanup of contaminated hazardous waste sites are under development. These technologies utilize specific organisms to degrade organic chemical contaminants to less toxic species. Two areas of development are the use of a white rot fungus (Phanerochaete chrysosporium) wood degrader for water and soil treatment of wood treating wastes. Nitrogen deficiency is generally used to induce lignin utilization. Liquid phase studies have demonstrated that the white rot fungus can degrade a variety of structurally diverse organic compounds; generally, chlorinated compounds were found to be mineralized more slowly than parent hydrocarbons. A water treatment process using P. chrysosporium is under investigation at the bench scale and will be applied to treatment of the waste derived from wood treating waste sites. Recent results show that this reactor will degrade 250 ppm pentachlorophenol in water to 5 ppm in 8 hr. The general success of solution biodegradation studies with the fungus stimulated speculation that this microorganism may be an appropriate candidate for the treatment of contaminated soils. Recent studies show that biomass accumulations as well as growth habitat were greatly influenced by soil type, and growth was strongly positively correlated with nitrogen content and increased soil water potential from -0.03 MPa. The application of

the fungus to soil treatment is the remediation of wood treating sites. Target pollutants identified for treatment at these sites are pentachlorophenol and the major aromatic hydrocarbon contaminants found in creosote. Future research in the soil application will include small scale treatment of selected pollutants at environmentally significant concentrations, the evaluation of amendments on primary and secondary metabolism, and the delivery of oxygen within the soil to the growing fungus. (See also W91-11805) (Fish-PTT)
W91-11815

ENVIRONMENTAL EFFECTS OF DREDGING: MANAGING DREDGED MATERIAL: EVALUATION OF DISPOSAL ALTERNATIVES IN THE NEW YORK-NEW JERSEY METROPOLITAN REGION.
Army Engineer District, New York.
For primary bibliographic entry see Field 5E.
W91-11827

WETLAND PROTECTION IN SUPERFUND REMEDIATIONS.
Wisconsin Univ.-Madison. Inst. for Environmental Studies.
C. H. Haynes.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-189435. Price codes: A05 in paper copy, A01 in microfiche. Report No. 600/9-89/012, 1988. 99 p, 3 fig, 19 ref, 6 append.

Descriptors: *Cleanup, *Environmental impact, *Legal aspects, *Site remediation, *Superfund, *Wetland mitigation, *Wetlands, Administrative agencies, Administrative decisions, Interagency cooperation, Policy making, Risk assessment.

Wetland protection at Superfund remedial sites is becoming an increasingly important concern, particularly on the East Coast of the U.S. where wetlands are frequently associated with Superfund sites. A study was performed to scrutinize the existing legal complexities of the issue of Superfund consideration of environmental impacts in risk assessments at wetland sites, the interactions of all major agencies involved, the role of Bioassessment Work Groups, and the subtleties of mitigation. The study reviewed the opinions of personnel from the Environmental Protection Agency, Department of the Interior, Fish and Wildlife Service, and the National Oceanic and Atmospheric Administration. The present legal structure does have the capacity to protect Superfund wetlands, though only through strict interpretation of existing laws, guidances, and policy statements. Recommendations include: (1) a single Policy Statement that definitively outlines existing legal requirements and concerns for the protection of wetlands and the environment on Superfund sites; (2) the goals of mitigation in all of its forms need to be identified; (3) available scientific information needs to be utilized to aid in the evaluation of the effectiveness of mitigation practices and to identify the needs for new studies; (4) uniform interpretation of existing laws, and ARARs (Applicable or Relevant and Appropriate Requirements) must be realized and applied; (5) increased cooperation, communication, and coordination between State and Federal agencies and within the Environmental Protection Agency is essential to the protection of wetlands; and (6) Bioassessment Work Groups should be mandatory in all Regions and have one or two individuals staffed full-time to coordinate activities for the group. (Fish-PTT)
W91-11831

SUPERFUND RECORD OF DECISION (EPA REGION 5): U.S. AVIEX, MI. (FIRST REMEDIAL ACTION), SEPTEMBER 1988.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-225502. Price codes: A02 in paper copy, A01 in microfiche. 7 September 1988. 8 fig, 10 tab.

Descriptors: *Chlorinated hydrocarbons, *Cleanup, *Groundwater pollution, *Industrial wastes, *Michigan, *Site remediation, *Soil contamination, *Superfund, *Water pollution treatment, Path of pollutants, Surface runoff, Trichloroethylene, Volatile organic compounds, Water pollution sources, Wells.

The six-acre U.S. Aviex site is located in the City of Niles, Howard Township, Cass County, Michigan. The site lies in a residential neighborhood with single family homes 100 feet to the south, east, and north. Because there are no storm or sanitary sewers nearby, surface runoff from the site and surrounding areas flows toward Bame-Huntly Drain, a tributary of St. Joseph River, and ultimately Lake Michigan. U.S. Aviex produced nonlubricating automotive fluids from the early 1960s until 1978. During operations at the plant, chlorinated hydrocarbons, including trichloroethane (TCA), were released into the vadose zone south of the process room. The subsurface soil still contains significant quantities of TCA, trichloroethylene (TCE), and tetrachloroethylene (PCE). In July 1972, an underground pipeline containing diethyl ether was broken during excavation near the west wall of the packaging room. Over the next several years, diethyl ether contamination was identified in downgradient residential wells southwest of the plant, approximately 0.5 mile away. U.S. Aviex installed six monitoring wells on the site beginning in 1972 and also provided alternate water supplies to homes with contaminated wells. In November 1978, a fire occurred on the site, and the large volumes of water used to extinguish the fire flushed unknown amounts of chemicals contained in barrels and tanks into the soil. Following the fire, chlorinated hydrocarbons were detected in domestic wells. Based on data developed during a groundwater investigation in 1982, a purge and treatment system using air stripping and discharge to surface water was designed and installed to contain the contamination. Contaminated groundwater, however, is currently flowing offsite to the southwest into residential areas. The primary contaminants of concern affecting soil and groundwater are volatile organic contaminants, including benzene, PCE, TCA, TCE, toluene, and xylenes. The selected remedial action for this site includes: soil flushing of approximately 11,500 cu yd of contaminated onsite soil; and collection of onsite and offsite groundwater and fluids from the soil flushing process with treatment onsite by air stripping, and discharge to surface water. The estimated present worth cost for this remedial action is $3,024,000. (Fish-PTT)
W91-11832

RCRA INSPECTION MANUAL.
Environmental Protection Agency, Washington, DC. Office of Solid Waste and Emergency Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-208169. Price codes: A17 in paper copy, A01 in microfiche. Report No. EPA/OWPE-88/001, April 22, 1988. 402 p, 2 fig, 5 append.

Descriptors: *Compliance, *Handbooks, *Inspection, *Resource Conservation and Recovery Act, *Water pollution control, Hazardous waste disposal, Hazardous wastes, Training, Waste management, Waste storage, Waste treatment, Wastewater facilities.

The RCRA Inspection Manual has been created to assist Resource Conservation and Recovery Act (RCRA) field inspectors in their performance of Compliance Evaluation Inspections of RCRA generators, transporters, and treatment, storage, and disposal facilities. Included in the document are inspection procedures for both interim status and permitted facilities. The guidance also provides inspection checklists to aid the inspectors in their review of facility compliance. Specific objectives are: to provide a detailed overview of the elements of RCRA Compliance Evaluation Inspections (CEIs); to describe the scope of inspector authorities and responsibilities; to provide detailed standard procedures for performing RCRA inspections; to provide general inspection information that is both comprehensive in scope and complements more detailed guidance on inspecting particular types of hazardous waste facilities; and to provide a manual that could serve as the basis for general training of new inspection personnel on RCRA inspection procedures. (Fish-PTT)
W91-11833

APPROXIMATE WATER-LEVEL CHANGES IN WELLS COMPLETED IN THE CHICOT AND EVANGELINE AQUIFERS, 1977-90 AND 1989-90, AND MEASURED COMPACTION, 1973-DECEMBER 1989, IN THE HOUSTON-GALVESTON REGION, TEXAS.
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11844

PROGRAMS AND ANALYTICAL METHODS FOR THE U.S. GEOLOGICAL SURVEY ACID RAIN QUALITY-ASSURANCE PROJECT.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W91-11856

REGENERATION PROPERTIES OF SPENT TAILORED SOILS.
New Mexico State Univ., Las Cruces. Dept. of Civil, Agricultural and Geological Engineering.
C. F. Cadena, and E. Cazares.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-159475. Price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 254, November 1990. 40p, 13 fig, 4 tab, 26 ref. USGS State Project No. 1345690.

Descriptors: *Adsorption, *Adsorption kinetics, *Clays, *Groundwater pollution, *Hazardous materials, *Organic compounds, *Soil regeneration, Bentonite, Benzene, Cation exchange, Isothermic tests, Soil types, Tailored soils, Toluene.

Natural clays have a large internal surface area potentially available for adsorption of hazardous organic compounds. The exchangeable cations in clay occupy the interlamellar spaces that separate the clay platelets. Water molecules form a hydrated shell around the exchangeable cations due to the hydrophilic nature of these ions. The presence of such water molecules hinders adsorption of hydrophobic pollutants. Therefore, the interlamellar area in clays is normally inaccessible to organic pollutants. Adsorption of organic pollutants with low molecular weight onto natural soils may be greatly enhanced by chemical modification, that is, tailoring, of the clay fraction of the soil. Tailoring agents include tetraalkylamine compounds which can effectively replace the natural exchangeable cation in the clays. Prior studies show that the adsorption capacity of soils for benzene and toluene are greatly increased by tailoring with tetramethylammonium (TMA+) cations. Economic feasibility of using this process hinges on the potential to regenerate the spent soils. Regeneration by volatilization of the adsorbate was investigated for three tailored soils; Wyoming bentonite, Glendale clay-loam, and a clay-loam soil collected in the Los Angeles area. A 48% decrease from the original value of K (the linear adsorption constant) was observed for bentonite after six regeneration cycles. The Los Angeles soil showed no significant degradation in its adsorption capacity for benzene after six regeneration cycles. The Glendale soil decreased its K values 62% from the original value after the same number of regeneration cycles. The adsorption capacity of tailored bentonite for toluene was reduced by 97% after six regeneration cycles. This decaying effect does not necessarily represent a decrease in equilibrium adsorption capacity. Rather, the kinetics of adsorption may play a significant role as the absorbent become more granular after repeated regenerations. Adsorption studies with o-xylene showed minimal adsorption for both virgin and regenerated tailored bentonite. For this reason, no regeneration studies were performed with o-xylene. (Cadena-NM St Univ.)
W91-11875

MICROBIAL ECOLOGY OF THIOBACILLUS FERROOXIDANS.
Alaska Univ., Fairbanks. Water Research Center.
For primary bibliographic entry see Field 5C.
W91-11908

GEOHYDROLOGIC FRAMEWORK AND AN ANALYSIS OF A WELL-PLUGGING PROGRAM, LEE COUNTY, FLORIDA.
Geological Survey, Fort Meyers, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11930

LIMITS OF PRIVATE RIGHTS IN PUBLIC WATERS.
For primary bibliographic entry see Field 6E.
W91-11954

WATER POLLUTION AND THE PUBLIC TRUST DOCTRINE.
For primary bibliographic entry see Field 6E.
W91-11955

ENVIRONMENTAL POLLUTION RESEARCH IN SOUTH AMERICA.
Sao Paulo Univ. (Brazil).
A. H. Miguel.
Environmental Science and Technology ESTHAG, Vol. 25, No. 4, p 590-594, April 1991. 1 fig, 1 tab, 1 ref.

Descriptors: *Air pollution, *Drinking water, *Environmental quality, *Foreign research, *Global warming, *Path of pollutants, *South America, *Water pollution control, Alcohols, Deforestation, Heavy metals, Mining effects, Pesticides, Research priorities.

This is a sample of published pollution research activities related to air, water, food and soil which were conducted in the past ten years in South America. Brazil, Argentina, Chile and Venezuela have conducted the majority of research projects. Water quality studies focus on the elimination of microbiological contamination from drinking water and the distribution of heavy metals in fresh and salt waters. Atmospheric lead concentration is decreasing in some South American countries as a result of reductions in the lead content of their gasoline, or as in Brazil, elimination of lead by using alcohols as fuels or as gasoline octane boosters. Studies were conducted to determine the characteristics of natural biogenic gases and aerosol particles in the Amazon Basin atmosphere during the dry season and also to measure contamination by mercury used in gold mining in the Amazon. Relatively few studies have been conducted using precipitation samples. Results of studies concerning soil and water pollution caused by pesticides and other pollutants can be found in institutional reports. Future research is needed to determine how the use of alcohols as neat fuels or additives affects the environment. Research is also needed to assess the effects that large-scale biomass and slash-burning may have on the air quality of urban centers and global warming. (Feder-PTT)
W91-11961

USE OF THE RAINS MODEL IN ACID RAIN NEGOTIATIONS IN EUROPE.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
L. Hordijk.
Environmental Science and Technology ESTHAG, Vol. 25, No. 4, p 596-603, April 1991. 3 fig, 1 tab, 24 ref.

Descriptors: *Acid rain, *Air pollution control, *Environmental policy, *Europe, *Model studies, *RAINS model, *Water pollution control, Air pollution, Environmental analysis, Path of pollutants, Policy making, United Nations.

The RAINS (Regional Acidification INformation and Simulation) model has been developed as a tool to assist policy advisors in evaluating options to reduce acid rain in Europe. It is presently being used by the executive body for the Convention on Long-Range Transboundary Air Pollution, under the auspices of the United Nations Economic Commission for Europe. RAINS consists of a set of submodels, each describing various aspects of acid rain. This model can be used in a scenario analysis and also an optimization analysis. RAINS covers all emissions that are considered to influence acidification of the environment and covers Europe as a whole. This model is politically accepted in Europe. Future acceptance requires that the model is adapted to new requirements, such as the development of abatement strategies based on critical loads. Broadening of RAINS is another necessary condition for continuing practical acceptance. Processes of external scientific review should also continue. (Author's abstract)
W91-11962

LABORATORY STUDIES OF SURFACTANT-ENHANCED WASHING OF POLYCHLORINATED BIPHENYL FROM SANDY MATERIAL.
General Motors Research Labs., Warren, MI. Environmental Science Dept.
A. S. Abdul, and T. L. Gibson.
Environmental Science and Technology ESTHAG, Vol. 25, No. 4, p 665-671, April 1991. 6 fig, 1 tab, 21 ref.

Descriptors: *Cleanup operations, *Decontamination, *Polychlorinated biphenyls, *Sandy soils, *Surfactants, Adsorption, Adsorption kinetics, Soil columns, Soil contamination, Soil washing.

To assess the suitability of an alcohol ethoxylate surfactant for washing contaminants from soils, the sorption of the surfactant by a sandy soil was studied and the extent of washing of polychlorinated biphenyls (PCBs) from the soil was evaluated. The surfactant adsorption is described by an S-shaped isotherm, consistent with a Langmuir-type monomolecular adsorption followed by adsorption of the surfactant micelles. After only 10 washings with water, the surfactant concentration in the effluent samples decreased from as high as 10,000 mg/L to less than 60 mg/L. PCBs could be effectively washed from the sand by using surfactant solutions. After 20 washings about 66, 86, and 56% of the PCBs were washed from the columns by 5000, 10,000 and 20,000 mg/L surfactant solutions, respectively. This is equivalent to a reduction in PCBs from 1728 mg/kg to about 614, 251 and 769 mg/kg, respectively. It is a good candidate for in-situ soil washing studies. Actual success in the field will depend on site-specific conditions such as the spatial variation of hydrologic and biologic properties and of material composition. (Author's abstract)
W91-11964

COST OF EDIBLE FISH--EFFECTS ON THE SWEDISH AND FINNISH FOREST INDUSTRIES FROM THE IMPOSITION OF EFFLUENT CHARGES ON CHLORINE RESIDUALS IN SWEDEN.
Sveriges Lantbruksuniversitet, Umea. Dept. of Forest Economics.
L. Hultkrantz.
Journal of Environmental Management JEVMAW, Vol. 32, No. 2, p 145-164, March 1991. 3 fig, 7 tab, 17 ref, 2 append.

Descriptors: *Baltic Sea, *Chlorine, *Cost analysis, *Economic impact, *Effluent charges, *Emission control, *Environmental policy, *Finland, *Marine pollution, *Organic pollutants, *Pulp and paper industry, *Pulp wastes, *Sweden, *Water pollution control, Economic incentives, Environmental protection, Marine fisheries, Mathematical models, Pollution taxes.

An urgent issue in environmental protection in Sweden and Finland is the reduction of discharges of organic chlorine compounds produced by bleached chemical pulp manufacturing into the Baltic Sea. To expedite the process, the Swedish Government is currently considering introduction of an effluent charge on chlorine residuals. This would raise the cost of chlorine-bleached pulp and paper products in Sweden and induce restructuring of the forest industries in both Sweden and Finland. A computable model for comparative static analysis on the long-term equilibrium on the Swedish and the Finnish pulpwood markets is developed. The marginal cost of emission control through product substitution is less than the marginal cost of technical purification measures to reduce discharges per unit of output. However, the role played by product substitution induced by an effluent charge will be minor in comparison to the effects that can be attained by traditional regulation through emission control. (Author's abstract)
W91-11973

OIL POLLUTION ACT OF 1990.
A. J. Rodriguez, and P. A. C. Jaffe.
Tulane Maritime Law Journal, Vol. 15, No. 1, p 1-28, Fall 1990.

Descriptors: *Environmental law, *Legislation, *Oil Pollution Act, *Oil pollution, *Oil spills, *Water pollution prevention, Cleanup, Economic impact, Federal jurisdiction, Liability, Marine pollution, Natural resources, Navigable waters, Ships, State jurisdiction, Water policy, Water pollution control.

On August 19, 1990 the United States adopted a new legal regime governing the discharge or threat of discharge of oil on the navigable waters, adjoining shorelines and exclusive economic zone of the United States. The Oil Pollution Act of 1990 is now the principal federal water pollution law; it establishes a comprehensive scheme for prevention, removal, liability, compensation and penalties relating to oil pollution. It is the harshest oil pollution legislation to date; it imposes considerably higher limits of liability on a vessel owner than do the international conventions, allows for potentially unlimited liability against a vessel owner under the laws of individual states, and creates exposure to a formidable range of penalties. There is no doubt that shipping costs will increase significantly and these costs will be passed onto the consumer. It is uncertain if this legislation will actually encourage safer methods of oil transportation and reduce the frequency and severity of pollution incidents. (Feder-PTT)
W91-11976

ENVIRONMENTAL FATE OF TOXIC WASTES, THE CERTAINTY OF HARM, TOXIC TORTS, AND TOXIC REGULATION.
C. B. Meyer.
Environmental Law EVLWA8, Vol. 19, No. 2, p 321-387, 1989. 323 ref.

Descriptors: *Environmental law, *Legal aspects, *Path of pollutants, *Population exposure, *Regulations, *Torts, *Toxic wastes, *Water pollution effects, Chemical industry, Economic aspects, Formaldehyde, Insurance, Liability, Negligence, Pesticides, Public health, Public policy, Social aspects.

The current toxic waste crisis is the result of the substantial growth of chemical manufacturing spawned by this scientific and technical revolution of the last half century. Initially, the public was willing to assume the risk of injuries accompanying the technical progress; however, the public is now realizing that the beneficial effects of these new products must be balanced against their side effects. The majority of chemical companies have discovered alternatives to polluting the environment with toxic waste, yet a powerful minority of the industry continues to use obsolete processes, technology, and manufacturing plants to save costs. These manufacturers no longer inadvertently dump toxic waste, but purposefully attempt to externalize costs and increase profits at the expense of others. Three toxic exposure problems including (1) exposure to indoor air pollution by formaldehyde, (2) exposure to pesticides, and (3) exposure to toxic waste as an act of battery are reviewed which demonstrate that environmental exposure may constitute an intentional invasion of property and bodily interests when toxic chemicals touch human victims. While proof of negligence is complex, the tools for dealing with toxic tort cases are

available. These tools include fingerprinting and quantifying toxic chemicals, determining the environmental fate of the toxics, calculating toxic exposure, and applying established legal doctrines with substantial certainty. Progress toward abolishing toxic waste dumping could occur if society would begin to treat toxic touching like any other form of harmful touching. The current regulation of toxics is not a cure-all for eliminating toxic waste because it concerns itself with the distribution of costs throughout society, rather than with the implementation of new technology. To be effective, the law must identify inefficient producers and coerce change in process chemistry and technology. Through the intentional tort theory, few industries will be able to argue with the concerned public that toxic touching should be tolerated, and the remaining toxic polluters would be forced to pay for their own damage liability and awards. (Collins-PTT)
W91-11978

BERSANI V. EPA: THE EPA'S AUTHORITY UNDER THE CLEAN WATER ACT TO VETO SECTION 404 WETLAND-FILLING PERMITS.
C. A. Klein.
Environmental Law EVLWA8, Vol. 19, No. 2, p 389-414, 1989.

Descriptors: *Clean Water Act, *Environmental law, *Environmental protection, *Judicial decisions, *Permits, *Regulations, *Wetland mitigation, Building codes, Legal aspects, Marshes, Massachusetts, Swamps, Urbanization, Wetland enhancement.

The national attitude toward marshes has changed dramatically over the past century. Congress, federal agencies, and the courts have struggled to keep pace as the public image of marshlands has evolved from worthless swamps to priceless wetlands. Section 404 of the Clean Water Act (Act) authorizes the Army Corps of Engineers (Corps) to regulate wetland filling through a permit system; however, the Environmental Protection Agency (EPA) is authorized to veto any of the Corps' section 404 permit decisions. Since 1972, the Corps has processed approximately 160,000 permit applications and the EPA has vetoed only five proceedings prior to Bersani v. EPA. In Bersani, the United States Court of Appeals for the Second Circuit upheld, and thereby encouraged, a rare effort by the EPA and the Corps' New England regional office to limit wetland filling by real estate developers. EPA indicated for the first time that adverse environmental effects caused by wetlands loss are unacceptable under section 404(b) of the Act if those effects are avoidable under section 404(c). Moreover, EPA adopted a 'market entry' theory that deemed wetland destruction avoidable if an alternative upland site existed when the builder first explored the real estate market, even if the alternative became unavailable by the time of permit application. The regulations implementing the Act require that the negative consequences of a project be reduced through mitigation measures. The developer submitted a mitigation proposal that relied heavily on the creation of artificial wetlands; however, EPA maintained a position that mitigation efforts were unsatisfactory because (1) the potential success of the replacement wetlands was scientifically uncertain, and (2) even if the attempt was successful, the habitat value of the artificial wetlands could not compensate for that lost. The Bersani decision indicates a judicial willingness to support agency activism to thwart wetland destruction. (Collins-PTT)
W91-11979

NONPOINT SOURCE POLLUTION, GROUNDWATER, AND THE 1987 WATER QUALITY ACT: SECTION 208 REVISITED.
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
R. D. Fentress.
Environmental Law EVLWA8, Vol. 19, No. 4, p 807-839, 1989.

Descriptors: *Clean Water Act, *Environmental law, *Legal aspects, *Nonpoint pollution sources, *Water Quality Act, *Water pollution control, Agricultural runoff, Environmental protection, Oregon, Regulations, Water law.

Nonpoint source (NPS) pollution is a complex problem that does not lend itself to a quick technological fix. It covers a broad range of activities such as agriculture and silviculture which have been traditionally regulated by local governments and occasionally state agencies. Section 208 of the Clean Water Act failed to control NPS pollution since state and local regulatory patterns were not sufficiently altered. The 1987 amendments to the Clean Water Act, referred to as the Water Quality Act, purported to establish a national nonpoint source program. While section 319 of the Water Quality Act contains new reporting and monitoring requirements and offers state financial incentives, it gives no additional enforcement authority to the EPA or the states. Thus, compliance continues to be voluntary. In addition, Congress has not appropriated funding for the program. If little progress is made by the states under section 319 and Congress wishes to address the NPS pollution problem, stronger measures may be proposed in the future. While the Water Quality Act offers some new proposals for addressing the NPS problem, it says little about addressing its effect on groundwater. Oregon's Section 319 Management Plan provides a blueprint for regulating NPS pollution according to land use, and provides a step in the right direction. Yet Oregon's Plan is still voluntary and does not focus on groundwater protection. (Collins-PTT)
W91-11980

PROTECTING OREGON'S FREE-FLOWING WATER.
For primary bibliographic entry see Field 6E.
W91-11981

WETLAND PROTECTION UNDER SECTION 404 OF THE CLEAN WATER ACT: AN ENFORCEMENT PARADOX.
For primary bibliographic entry see Field 6E.
W91-11986

SLUDGE REGULATIONS STRESS BENEFICIAL USE.
The Chester Engineers, Pittsburg, PA.
D. W. Hacker.
Environmental Protection, Vol. 2, No. 3, p 23-25, April/May 1991.

Descriptors: *Beneficial use, *Regulations, *Sludge disposal, *Sludge utilization, *Waste disposal, Economic aspects, Environmental Protection Agency, Environmental protection, Heavy metals, Incineration, Land disposal, Pathogens, Public health.

Although solid waste and sewage sludge regulations have been given priority only sporadically in the past, EPA recently has made an effort to promulgate final regulations for sewage sludge disposal that are expected to be completed in January 1992. The proposed sewage sludge disposal regulations address five different sludge management practices: land application, that would apply to the application of sewage sludge to either agriculture or non-agricultural land; distribution and marketing, that would include national pollutant limits based on intended use for marketed sludge; monofills and surface disposal, with specified regulation in regard to closure plans, pollutant levels, maintenance, covers, access, etc.; incineration, with established limits for beryllium, mercury, lead, arsenic, cadmium, chromium, nickel and total hydrocarbons in sewage sludge prior to incineration; and addition requirements in regard to pathogen and vector control and monitoring programs. The regulations are designed to encourage practices that reuse sewage sludge for its beneficial qualities, yet ensure protection of human health and the environment. (White-Reimer-PTT)
W91-11990

EPA EVALUATING BYPRODUCT RULE.
Hazen and Sawyer, Richmond, VA.
G. Budd.
Environmental Protection, Vol. 2, No. 3, p 29-30,51, April/May 1991.

Descriptors: *Administrative regulations, *Disinfection byproducts, *Environmental Protection Agency, *Safe Drinking Water Act, *Water treatment, Analytical methods, Chlorination, Coagulation, Laboratory equipment, Management planning, Ozone, Water treatment facilities.

The Safe Drinking Water Act and its amendments are having a profound effect on water utility planning. One of the potentially significant areas of impact involves health concerns related to disinfection byproducts. The Environmental Protection Agency initially had projected that a proposed rule would be published in the fall of 1991, with a final rule anticipated between the fall of 1992 and mid-1993. However, since this rule involves complex issues and a potential for limiting disinfection alternatives, possibly in ways that might conflict with goals for maintaining control over waterborne disease, the EPA has indicated that more time is needed for rule development. Prominently mentioned control methodologies for disinfection byproducts have included use of alternative disinfectants such as ozone and possibly chlorine dioxide, and use of optimized coagulation processes for removing precursor compounds. In spite of regulation uncertainty, treatment plant planning must proceed. Key factors are maintaining flexibility in plant layout to incorporate new or modified processes and timely decision-making to meet regulatory deadlines. Preliminary testing to screen the effects of alternative technologies also can be considered, leaving room for additional evaluations in the future when more is known considering specific byproduct limits. Utilities also might begin to consider the need for personnel to deal with these complex issues in the laboratory. Analytical methodologies for performing evaluations will become more complex, requiring capable personnel equipped with more sophisticated equipment. (White-Reimer-PTT)
W91-11991

RCRA GIVES TSDFS NO ROOM FOR ERROR.
Little (Arthur D.), Inc., Cambridge, MA.
G. G. Crognale.
Environmental Protection, Vol. 2, No. 3, p 36-39,41, April/May 1991.

Descriptors: *Compliance, *Hazardous waste disposal, *Regulations, *Resource Conservation and Recovery Act, *Solid waste disposal, *Waste disposal, *Water pollution control, Databases, Enforcement, Environmental protection, Monitoring, Waste management, Waste minimization, Waste utilization.

A major concern of any Treatment, Storage and Disposal Facility (TSDF) is compliance with the Resource Conservation and Recovery Act (RCRA). Through proper planning, owners and operators can identify areas where potential releases may occur, thereby preventing problems before a corrective action becomes necessary. Amendments enacted in November 1984 to the RCRA required facilities to identify their Solid Waste Management Units (SWMUs) and determine if releases had occurred. Since releases of hazardous constituents from these SWMUs not only may include clearly defined regulated units but also areas where solid waste has been routinely and systematically released, a general characterization may be made in adopting techniques used in groundwater monitoring and closure for corrective action guidance. A comprehensive inspection can go far in assuring adequate post-closure care. Any deficiencies noted during an inspection should be logged and properly addressed. Currently, Congress is evaluating the reauthorization of RCRA/HSWA (Hazardous and Solid Waste Amendments). Areas where enhancement may occur include enforcement, corrective action/closure, state authorizations and waste minimization. Under corrective action, EPA now has the appropriate mechanism and database to reassess and reprioritize facilities according to environmental significance. Many generators and TSDFs also are conducting an increasing number of environmental

audits to maintain and exceed compliance requirements. Waste minimization is growing in importance as more facilities attempt to reduce the amount of hazardous waste they generate, thereby reducing the amount of waste in need of disposal. (White-Reimer-PTT)
W91-11992

ELECTRICITY SEALS IMPOUNDMENT LEAKS.
Southwest Research Inst., San Antonio, TX. Environment and Geophysical Applications Section.
G. T. Darilek.
Environmental Protection, Vol. 2, No. 3, p 44-47, April/May 1991.

Descriptors: *Electric currents, *Hazardous waste disposal, *Leakage, *Reservoir linings, *Waste disposal, *Wastewater lagoons, *Water pollution prevention, Bentonite, Clays, Electrophoresis, Environmental protection, Inspection, Liners, Maintenance.

The application of an electrical inspection technique has become a highly successful means of detecting and locating leaks in the liners of surface impoundments built to hold hazardous and municipal liquid wastes. However, until now, no effective, economical method has existed to repair a liner system after the introduction of waste. Researchers have developed a sealing method that takes advantage of the migrating particle effect of electrophoresis along with the action of bentonite clay. An electric current flows through leaks in the liner, establishing a strong electric field in the vicinity of each leak. When a bentonite slurry is added, electrophoresis causes the clay particles to move along the lines of current flow, becoming concentrated at leaks in the geomembrane. Because of the decreased mobility of the clay particles penetrating to the sand or geotextile immediately beneath the leak sites and the tendency of bentonite to swell appreciably when wet, clay accumulating in and near the leaks compacts to form an impermeable barrier. Test results suggest that applying a thin layer of clay directly on the liner in new installations, before placement of a protective soil cover, would effectively increase the concentration of clay available to seal leaks. Fully developed, this simple and inexpensive technique can contribute significantly to protection of the environment, particularly the nation's groundwater. (White-Reimer-PTT)
W91-11993

NITROGEN LEACHING LOSSES FROM IRRIGATED ORCHARDGRASS ON SANDY SOILS.
Nebraska Univ.-Lincoln. Dept. of Biological Systems Engineering.
For primary bibliographic entry see Field 5B.
W91-11995

PROTECTING BIODIVERSITY IN COASTAL ENVIRONMENTS: INTRODUCTION AND OVERVIEW.
Virginia Univ., Charlottesville. Div. of Urban and Environmental Planning.
For primary bibliographic entry see Field 2L.
W91-12023

CHALLENGE OF PROTECTING ENDANGERED SPECIES HABITAT ALONG THE SOUTHERN CALIFORNIA COAST.
San Diego State Univ., CA.
J. B. Zedler.
Coastal Management CZMJBF, Vol. 19, No. 1, p 35-53, January/March 1991. 1 fig, 26 ref. NOAA Grant No. NA81AA-D-SG140 and Project No. R/CZ-82.

Descriptors: *California, *Coastal environment, *Coastal zone management, *Endangered species, *Environmental protection, *Regulations, Coastal wetlands, Ecosystems, Legal aspects, Legislation, Public policy, Salt marshes, Wetlands.

The southern California coast is rich in species that are habitat-dependent. Three endangered birds and one plant species depend on coastal wetlands that cover < 25% of their historic area and are far from pristine. Despite laws that protect wetlands and endangered species, regulatory agencies still permit habitat alterations if mitigation plans promise compensation. Lost habitat is usually replaced by restoring disturbed wetlands, with a net loss of wetland acreage and often a decline in habitat quality. Although the emerging policy of not net loss seeks to maintain both habitat area and functioning, even mitigation projects with the highest standards do not fulfill such goals. One five-year-old salt marsh adjacent to San Diego Bay was constructed as a habitat for an endangered bird, but it lacks that species and is deficient in food chain support, plant productivity, and nutrient supply functions. It should be possible to accelerate development of these ecosystem processes, using scientific knowledge and experimentation at existing mitigation projects. Meanwhile, if biodiversity is to be protected, mitigation policies must be put on hold until constructed wetlands are proved capable of attracting and sustaining the full complement of native species. (Author's abstract)
W91-12025

ROLE OF FDA IN ESTABLISHING TOLERABLE LEVELS FOR DIOXIN AND PCBS IN AQUATIC ORGANISMS.
Food and Drug Administration, Washington, DC. Center for Food Safety and Applied Nutrition.
I. J. Boyer, C. J. Kokoski, and P. M. Bolger.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 33, No. 1, p 93-101, May 1991. 21 ref, append.

Descriptors: *Dioxins, *Polychlorinated biphenyls, *Public health, *Regulations, *Toxicology, *Water quality control, Aquatic environment, Fish, Food and Drug Administration, Legislation.

When fishery products shipped in interstate commerce contain an environmental contaminant that presents a potential threat to public health, the Food and Drug Administration (FDA) undertakes appropriate regulatory steps to minimize exposure. These efforts range from seizure of the affected product to formal rule-making to establish a limit. The basic provision of the Food, Drug, and Cosmetic (FD and C) Act by which the agency deals with environmental contaminants in the food supply is section 402(a)(1), which deals with poisonous and deleterious substances. Poisonous and deleterious components are deemed to be 'added,' even if they are natural constituents of food, if any amount is present through the artifice of man. Furthermore, when the level of a naturally occurring toxic in increased the food through handling and/or processing, the sum of all of the contaminant is deemed to be 'added.' Unavoidable environmental contaminants may be controlled and/or regulated under this section by the 'may render injurious' standard, whereby the agency must demonstrate that there is a significant possibility that exposure to the contaminant could be injurious to human health. 'Action levels' are administrative guidelines or instructions to the agency field units that define the extent of contamination at which the agency may regard food as adulterated. Except for polychlorinated biphenyls (PCBs), for which there is a tolerance established by regulation, FDA has controlled contaminants in aquatic organisms by using action levels. Under section 406 of the FD and C act, the agency can also establish tolerances for unavoidably added poisonous or deleterious substances. This section allows the agency to consider the extent to which a contaminant is unavoidable in food while it limits exposure to the extent necessary to protect the public health. Section 406 requires that the tolerance be established by assessing several factors, including risk. Although the FDA has no statutory authority over intrastate fishing considerations, such as noncommercial fishing, it does provide advice to local or state authorities. (Lantz-PTT)
W91-12036

SITE SAMPLING AND TREATABILITY STUDIES FOR DEMONSTRATION OF WASTECHEM'S ASPHALT ENCAPSULATION TECHNOLOGY UNDER EPA'S SITE PROGRAM.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
J. Hubbard, S. Tsadwa, N. Willis, and M. Evans.
Journal of the Air & Waste Management Association JAWAEB, Vol. 40, No. 10, p 11436-1441, October 1990. 4 fig, 2 tab, 4 ref.

Descriptors: *Asphalt, *Cleanup operations, *Site remediation, *Technology, *Water solidification, Encapsulation, Metals, New Jersey, Sampling methods, Volatile organic compounds, Waste treatment, Woodland Township Route 532 Site.

The US EPA is conducting demonstrations of a number of innovative cleanup technologies at Superfund sites across the nation. Conducted under the Superfund Innovative Technology Evaluation (SITE) program, the purpose of these technology demonstrations is to evaluate the capabilities and costs of innovative technologies under actual field conditions. One such technology is the WasteChem technology which dries and grinds wastes into fine particles as they are encapsulated in a hot (approximately 300 F) liquid asphalt binder, which then solidifies at ambient temperatures. A major advantage of the WasteChem technology is that it reduces the volume of the wastes and thus reduces the cost handling and disposing of the treated material. The amount of reduction achieved is a function of the water content of the waste. A demonstration of the technology was conducted at the Woodland Township Route 532 site in New Jersey. The results of sampling showed high variability in contaminant concentrations within sampling distances of 10 to 20 ft. This variability illustrates the importance of collecting a number of samples in each prospective waste source area during preliminary sampling at sites that are candidates for SITE demonstration. Compositing is one method of taking a number of samples from each waste source area while avoiding the cost of multiple analyses in each area. However, compositing samples does not allow the identification of concentration gradients within a sampling area. However, compositing samples does not allow the identification of concentration gradients within a sampling area. One method of identifying gradients while avoiding excessive analytical costs is to take one composite sample for a complete analysis and several other samples for analysis of key contaminants only. The WasteChem process reduced the concentrations of leachable solid volatile organic compounds in wastes from one location at the Woodland Township Route 532 site. (Lantz-PTT)
W91-12039

POSSIBILITIES OF SOIL CLEAN-UP (MOGLICHKEITEN ZUR BODENSANIERUNG).
Umweltbundesamt, Berlin (Germany, F.R.).
V. Franzius.
Chemie-Ingenieur-Technik CITEAH, Vol. 63, No. 4, p 348-352, 357, 358, April 1991. 3 tab, 8 ref. English summary.

Descriptors: *Cleanup, *Hazardous waste disposal, *Soil contamination, *Water pollution prevention, *West Germany, Biological treatment, Chemical treatment, Enforcement, Heat treatment, Industrial plants, Public health, Research, Technology, Waste treatment.

In West German waste disposal legislation, abandoned hazardous sites are defined as abandoned waste sites or industrial sites that pose a threat to human health, the environment, or other aspects of public safety. The Federal German States are charged with enforcing the cleanup of such sites. Registration and evaluation programs are underway. To date, nearly 50,000 suspected sites are registered in the former States of the Federal Republic of Germany and nearly 28,000 in the new states. Evaluations have been conducted at more than 100,000 suspected sites. Several cleanup techniques have been funded within the framework of R & D programs. Cleanup technologies in practical use include thermal treatment, physicochemical treatment (soil washing and soil venting), and biological treatment. Future trends focus on combined treatment technologies in so-called soil treatment centers. (Author's abstract)
W91-12042

POPULATION, DEVELOPMENT AND MARINE POLLUTION IN CHINA.
Institute of Marine Environmental Protection, Dalian (China).
Z. Fan, and R. P. Cote.
Marine Policy MAPODG, Vol. 15, No. 3, p 210-219, May 1991. 2 tab, 57 ref.

Descriptors: *China, *Environmental effects, *Human population, *Industrial development, *Marine pollution, *Water pollution control, *Water pollution sources, Agricultural runoff, Coastal zone management, Fisheries, Industrial wastes, Oil pollution, Water pollution prevention, Water quality control.

Population increases and poor economic growth are underlying factors leading to the deterioration of the marine environment in the People's Republic of China. Jinzhous Bay on the Bohai Sea is heavily polluted by oil and heavy metals. Liaodong Peninsula in Dalian Bay is also seriously polluted with oil. Oil pollution has jeopardized fishery resources, and may also threaten human health. Domestic wastes are dumped into marine waters without being properly treated. Fish habitats in the intertidal zones have also been destroyed. Coastal agriculture endangers the quality of marine waters from runoff of fertilizers and pesticides. Industrial pollution from coastal and inland industries also poses a threat to marine water quality. Overpopulation in China has caused overfishing and destruction of marine habitats which have furthered destruction of the coastal fisheries. Oil exploitation off the coasts of China have resulted in increased oil spills. A five-year plan to meet marine environmental quality objectives includes: maintaining water quality in good areas; lessening the degree of pollution in marginal coastal and estuarine areas; cleaning up seriously polluted areas; and planning for the integrity of coastal zones by an ecosystem approach. To implement such a plan, cooperation of administrative, economic, technological and educational initiatives will be required. (Geiger-PTT)
W91-12066

NEXT GENERATION OF COMPUTERIZED PROCESS CONTROL.
Metcalf and Eddy, Inc., Laurel, MD.
For primary bibliographic entry see Field 5D.
W91-12074

NEW CLEAN AIR ACT.
A. Padmanabha, and H. Olem.
Water Environment & Technology WAETEJ, Vol. 3, No. 5, p 40-46, May 1991.

Descriptors: *Acid rain, *Air pollution, *Clean Air Act, *Ozone, *Path of pollutants, *Water pollution control, *Water pollution effects, Permits, Volatile organic compounds, Water pollution sources.

The Clean Air Act (CAA) amendments signed into law on November 15, 1990, should improve air quality and help to restore and protect lakes and streams by reducing acid-rain-causing emissions and toxics from nonpoint-sources. The reduction of volatile organic compound (VOC) emissions for reducing urban smog and the control of toxic and cancer-causing pollutants is expected to affect wastewater treatment plants and their sewer systems. Because of stringent emission reduction requirements, states and the EPA will regulate VOC emissions from publicly owned treatment works. The amendments establish a compliance strategy for each area failing to attain the national ambient air-quality standards for ozone. Similarly for VOCs, carbon monoxide, and particulate, each area not attaining the standard must comply within a certain time period by implementing control measures for these substances. The 1990 CAA establishes stricter standards for emissions from automobiles and trucks and requires the use of cleaner burning fuels. The CAA requires updated lists of hazardous pollutants and their sources and requires EPA to set maximum available control technology standards for each listed source category according to a prescribed schedule. The law requires EPA to evaluate whether the technology-based standards for hazardous pollutants reduce the lifetime excess cancer risk to $< 1{:}1{,}000{,}000$ to the most-exposed individual. If the risk is greater, EPA must promulgate more stringent health-based standards for the source. The CAA requires EPA to establish standards for stationary area sources of hazardous air pollutants, such as dry cleaners, service stations, and printers that threaten human health or the environment. The law requires EPA to list 100 substances that, in the case of accidental releases, may cause fatalities, injury, or serious adverse health and environmental effects. On the initial list are chlorine and sulfur dioxide used in wastewater treatment. To achieve a reduction in sulfur dioxide emissions by the year 2000, the EPA will allocate allowances that may be bought and sold to achieve required emission reductions. Title V of the 1990 CAA requires various sources of air pollution to obtain operating permits to ensure compliance with all applicable requirements of the law. Other titles under the new CAA will phase out ozone-depleting chemicals, allow criminal penalties for CAA violations, and offer support for clean air research and technology. (Geiger-PTT)
W91-12076

DISCHARGE BORDER WARS.
N. J. Sweeney.
Water Environment & Technology WAETEJ, Vol. 3, No. 5, p 51-53, May 1991.

Descriptors: *Clean Water Act, *Environmental law, *Interstate rivers, *Water law, *Water pollution control, *Water quality standards, Arkansas, Effluents, Environmental Protection Agency, Illinois River, Legal aspects, Oklahoma, Permits.

The U.S. Court of Appeals for the Tenth Circuit recently ruled on a dispute involving Oklahoma, Arkansas, and EPA on conflicting claims over whose water quality standards apply to discharges into interstate waterways. The dispute began when the city of Fayetteville, Arkansas, applied for a National Pollutant Discharge Elimination System (NPDES) permit for its new municipal wastewater treatment plant. At the time, Arkansas had not been delegated permitting authority pursuant to the Clean Water Act (CWA), so the application was made directly to EPA. Part of the Fayetteville plant's discharge finds its way into the Illinois River that crosses into Oklahoma about 63 km downstream from the plant. Oklahoma challenged the application, arguing that Oklahoma's EPA approved state water quality standards, which were more stringent than the federal NPDES standards, should apply to the Fayetteville plant permit, because any discharge would make its way into Oklahoma and affect its water quality. Arkansas argued that Oklahoma standards could not be applied to an Arkansas discharger. EPA agreed that the Oklahoma water quality standards did apply, but decided that issuing the permit would not result in any violations of Oklahoma's water quality standards. The permit was issued with a provision for incorporating more stringent limitations if an ongoing study of the downstream Illinois River demonstrated that such requirements were needed to ensure compliance with the Oklahoma water quality standards. Oklahoma and Arkansas appealed EPA's decision to the federal court of appeals. Arkansas challenged EPA's finding that Oklahoma's water quality standards applied to an Arkansas discharger and the requirement that the permit be modified to comply with Oklahoma standards. Oklahoma agreed with EPA that Oklahoma standards applied, but disagreed that the Fayetteville plant discharge would not violate Oklahoma's standards. The court's decision was a clear victory for Oklahoma and the ability of a downstream state to limit an upstream discharge that degrades the downstream state's water quality. (Geiger-PTT)
W91-12078

BALANCING FLOW FOR CSO ABATEMENT.
New York City Dept. of Environmental Protection.
For primary bibliographic entry see Field 5D.
W91-12079

ENVIRONMENTAL MEASURES IN SEWAGE WORKS.
Yokohama City Sewage Works Bureau (Japan).
S. Kaneko, and K. Yamanaka.
Water Environment & Technology WAETEJ, Vol. 3, No. 5, p 59-62, May 1991. 3 tab.

Descriptors: *Air pollution, *Environmental protection, *Japan, *Odor control, *Soil treatment, *Wastewater facilities, *Wastewater treatment, *Water pollution control, Aeration, Environmental effects, Filter media, Ion exchange, Ozonation, Recreation.

National wastewater treatment programs in Japan have helped prevent the generation of environmental problems caused by wastewater facilities in urban areas and have harmonized facilities with the surrounding environment. Deodorization methods enacted in 1965 consisting of simple water scrubbing methods have been replaced by water washing, ozonation, absorption, chemical washing, ion exchange resin methods, soil treatment, aeration, perpendicular combustion, and combinations of these methods. The Air Pollution Control Law of Japan regulates the discharge by sludge incinerators of sulfur and nitrogen oxides, hydrogen chloride, and dust. Incinerators have air pollution control equipment that treats exhaust gases. After passing through a heat exchanger, exhaust gas from fluidized bed furnaces goes through a cyclone separator where large suspended particles are eliminated. Next, sulfur oxides, hydrogen chloride, and suspended particles of a certain size are eliminated with scrubbers using water and alkali. Electrostatic precipitators are used to reduce the concentration of minute suspended particles. Denitrification equipment is installed to handle nitrogen oxide emissions. The Aqua-Topia project encourages citizen contact with clean water and promotes wastewater treatment facilities in urban areas. The amenity sewerage project introduces treated water into open city conduits to restore these small streams. Fifteen sites were selected in 1988 as Water Squares to beautify open conduits and riverside sites through the city. Other sewerage appeal projects aim to make wastewater treatment facilities more attractive to local residents by improving the environment surrounding the plants. (Geiger-PTT)
W91-12080

LEACHATE TREATMENT IN LANDFILLS.
SCS Engineers, Inc., Long Beach, CA.
N. G. Zolten.
Water Environment & Technology WAETEJ, Vol. 3, No. 5, p 63-66, May 1991. 4 tab.

Descriptors: *Landfills, *Leachates, *Waste disposal, *Wastewater treatment, *Water pollution control, *Water pollution prevention, Activated sludge, Clarification, Landfill linings, Sand filters.

Current and proposed regulations for municipal solid waste landfills include requirements for leachate collection, leachate treatment, and low liner permeability to prohibit leachate migration. The key components in leachates influencing the choice of treatment process are organics, solids content, and nitrogen. In addition to the leachate composition, the POTW effluent standards dictate the type of leachate treatment process necessary. Leachates can be treated to required standards by biological processes. Two-stage activated sludge should be used to bring the effluent within the required standards. Other necessary processes include an equalization tank, a primary clarifier, first-stage clarifier, second-stage clarifier, and rapid sand filter. Sludge treatment processes include an anaerobic digester and a belt filter press. The second-stage clarifier should be larger than the first-stage clarifier to provide more room for settling and enhance settling if nitrification is added to the system. Rapid sand filtration polishes the effluent and removes any remaining suspended solids and BOD. (Geiger-PTT)
W91-12081

MINERALIZATION OF DISSOLVED ORGANIC PHOSPHORUS FROM A SHALLOW EUTROPHIC LAKE.
Agriculture and Food Science Centre, Belfast

(Northern Ireland). Food and Agricultural Microbiology Research Div.
For primary bibliographic entry see Field 5B.
W91-12091

REVIEW OF THE SALT SENSITIVITY OF THE AUSTRALIAN FRESHWATER BIOTA.
Chisholm Inst. of Tech., Melbourne (Australia). Center for Stream Ecology.
B. T. Hart, P. Bailey, R. Edwards, K. Hortle, and K. James.
Hydrobiologia HYDRB8, Vol. 210, No. 1/2, p 105-144, March 1991. 5 fig, 1 tab, 116 ref.

Descriptors: *Australia, *Irrigation-return flow, *Saline water, *Salinity, *Wastewater disposal, *Water pollution control, Agriculture, Algae, Amphibians, Aquatic macrophytes, Birds, Data collections, Environmental effects, Mammals, Reptiles, Wetlands.

In Victoria, Australia, both dryland salinity and salinity in irrigation regions are serious agricultural problems. One option to control the latter is to pump groundwater to maintain it below the surface. However, this leaves a saline wastewater for disposal, probably into streams and wetlands. The salt sensitivity of the biota of Australian streams and wetlands has been reviewed to provide information useful to those responsible for developing controls on these discharges. Lethal and sublethal effects of salinity on microbes (mainly bacteria), macrophytes, micro-algae, riparian vegetation, invertebrates, fish, amphibians, reptiles, mammals, and birds were addressed. The data suggest that direct biological effects are likely to occur in Australian river, stream, and wetland ecosystems if salinity is increased to around 1000 mg/L. Data are particularly weak regarding the effects of increases in salinity on freshwater plants and animals. (Author's abstract)
W91-12104

DESIGNING WETLANDS FOR CONTROLLING COAL MINE DRAINAGE: AN ECOLOGIC-ECONOMIC MODELLING APPROACH.
Ohio State Univ., Columbus. School of Natural Resources.
K. A. Baker, M. S. Fennessy, and W. J. Mitsch.
Ecological Economics, Vol. 3, No. 1, p 1-24, March 1991. 5 fig, 5 tab, 42 ref.

Descriptors: *Coal mine wastes, *Mine drainage, *Wastewater disposal, *Wastewater treatment, *Wetland wastewater treatment, Computer models, Economic aspects, Iron, Model studies, Simulation analysis, Wetland waste treatment.

A simulation model was developed to test the efficiency and economics of using wetlands to receive and treat coal mine drainage. The computer model consists of a series of simultaneous time-dependent differential equations and associated algebraic equations using the STELLA (Structural Thinking Experiential Learning Laboratory with Animation) program. The model is calibrated by comparing output to field data from the Simco Wetland in Coshocton County, Ohio. The chemical aspects of the model are validated by comparing Tennessee Valley Authority actual field data for ten wetland sites to model outputs. An economic sub-model which compares wetland cost with conventional treatment is based on unit costs obtained from various sources in the coal mining industry. The model predicted that iron removal was closely tied to loading rates and that the cost of wetland treatment was less than that of conventional treatment for iron loading rates of 20-25 g Fe/sq m/day and removal efficiencies < 85%. To achieve these conditions in a wetland would cost approximately $50,000/yr. When higher loading rates exist and higher efficiencies are needed, wetland systems are more costly than conventional treatment methods. (Geiger-PTT)
W91-12112

USE OF WETLANDS FOR WATER QUALITY IMPROVEMENT UNDER THE USEPA REGION V CLEAN LAKES PROGRAM.
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
J. C. Landers, and B. A. Knuth.
Environmental Management EMNGDC, Vol. 15, No. 2, p 151-162, March/April 1991. 5 tab 29 ref. New York Sea Grant Institute, NOAA Office of Sea Grant, US Department of Commerce Grant NA86AA-D-SG045.

Descriptors: *Lake restoration, *Nutrient removal, *Water pollution control, *Water quality management, *Wetlands, Cleanup operations, Evaluation, Project planning, Recreation, Wildlife habitats.

The United States Environmental Protection Agency (USEPA) Region V Clean Lakes Program employs artificial and modified natural wetlands in an effort to improve the water quality of selected lakes. The use of wetlands at seven lake sites was examined and the physical and institutional means by which wetland projects are implemented and managed, relative to USEPA program goals and expert recommendations on the use of wetlands for water quality improvement, were evaluated. Management practices recommended by wetlands experts addressed water level and retention, sheet flow, nutrient removal, chemical treatment, ecological and effectiveness monitoring, and resource enhancement. Institutional characteristics recommended include: local monitoring, regulation, and enforcement and shared responsibilities among jurisdictions. Institutional and ecological objectives of the National Clean Lakes Program were met to some degree at every site, with social objectives achieved to a lesser extent. Wetland protection mechanisms and appropriate institutional decentralization were present at all sites. Optimal management techniques were employed to varying degrees at each site, but most projects lacked adequate monitoring to determine adverse ecological impacts and effectiveness of pollutant removal and did not extensively address needs for recreation and wildlife habitat. There is evidence that the wetland projects are contributing to improved lake water quality; however, more emphasis needs to be placed on wetland protection and long-term project evaluation. (Author's abstract)
W91-12115

REGULATION OF DISCHARGE OF ORGANOCHLORINES FROM PULP MILLS IN CANADA.
British Columbia Univ., Vancouver. Faculty of Law.
For primary bibliographic entry see Field 5D.
W91-12116

USE OF ADJUVANTS TO MINIMIZE LEACHING OF HERBICIDES IN SOIL.
Florida Univ., Lake Alfred. Citrus Experiment Station.
A. K. Alva, and M. Singh.
Environmental Management EMNGDC, Vol. 15, No. 2, p 263-267, March/April 1991. 2 fig, 1 tab, 27 ref.

Descriptors: *Groundwater pollution, *Herbicides, *Leaching, *Path of pollutants, *Water pollution prevention, Activated carbon, Benzoic acid herbicides, Chemical treatment, Dicamba, Humic substances, Leachates, Polymers, Simazine, Triazine herbicides.

Excessive leaching of herbicides affects their efficacy against target weeds and results in contamination of groundwater. Use of adjuvants that can weakly bind herbicides and in turn release them slowly is a valuable technique to prolong the efficacy of herbicides and to minimize their leaching into groundwater. Effects of activated charcoal, three humic substances (Enersol SP 85%, Enersol 12%, and Agroliz), or a synthetic polymer (Hydrosorb) on the leaching of bromacil, dicamba, and simazine were investigated in leaching columns using a Candier fine sand (Typic Quartzipsamment). The addition of adjuvants had no harmful effects on the physical properties of the soil as evident from lack of its affects on water percolation. When no adjuvants were used, 69% of dicamba, 37% of bromacil, and 4% simazine of applied were leached in the first pore volume of leachate (approximately 3.2 cm rainfall); bromacil and dicamba were leached completely and only 80% of simazine was leached. Using the adjuvant Enersol 12% resulted in a 13-18% reduction in leaching of dicamba and bromacil in five pore volumes of leachate. The leaching of simazine was significantly decreased when any of the five adjuvants mentioned were used. However, the decrease in leaching was significantly greater when using Enersol SP 85% or Enersol 12% (24-28%) than when using the other adjuvants (12-16%). (Author's abstract)
W91-12119

USEFULNESS OF NATURAL REGIONS FOR LAKE MANAGEMENT: ANALYSIS OF VARIATION AMONG LAKES IN NORTHWESTERN WISCONSIN, USA.
Corvallis Environmental Research Lab., OR.
J. M. Omernik, C. M. Rohm, R. A. Lillie, and N. Mesner.
Environmental Management EMNGDC, Vol. 15, No. 2, p 281-293, March/April 1991. 8 fig, 1 tab, 28 ref. EPA Contract 68-C8-0006.

Descriptors: *Lake management, *Lake restoration, *Lakes, *Land use, *Maps, *Phosphorus, *Water pollution control, *Wisconsin, Data interpretation, Regional analysis, Spatial distribution, Water quality monitoring, Water resources management.

A map of summer total phosphorus in lakes was compiled for a three-state area of the upper Midwest to identify regional patterns of total phosphorus in lakes and attainable lake trophic state. Spatial patterns in total phosphorus from approximately 3000 lakes were studied in conjunction with maps of geographic characteristics that tend to affect phosphorus balance in lakes, to identify regions of similarity in phosphorus concentrations in lakes or similarity in the mosaic of values as compared to adjacent areas. While degrees of relative homogeneity are apparent at many scales, the map was designed at a scale that would yield regions with sufficient homogeneity to be useful for lake management throughout the area. Data from 210 lakes in a 1560 sq m area in northwestern Wisconsin, sampled by the Wisconsin Department of Natural Resources in the spring of 1988 were examined to: (1) substantiate the existence of the regions depicted on the phosphorus map in northwest Wisconsin; (2) determine the nature and relative precision of the regional boundaries; (3) determine the relative importance of natural and anthropogenic watershed characteristics, lake types, lake area, and lake depth in explaining within-region differences in lake phosphorus; and (4) demonstrate how the regions might be used by local lake managers to control lake water quality. (Author's abstract)
W91-12121

COMPARISON OF METHODS FOR THE EXTRACTION OF PENTACHLOROPHENOL FROM AQUEOUS AND SOIL SYSTEMS.
Nova Scotia Agricultural Coll., Truro. Environmental Microbiology Lab.
For primary bibliographic entry see Field 5A.
W91-12141

ASSESSMENT OF METHODS FOR ESTIMATING AQUATIC HAZARDS AT SUPERFUND-TYPE SITES: A CAUTIONARY TALE.
Menzie-Cura and Associates, Inc., Chelmsford, MA.
D. E. Burmaster, C. A. Menzie, J. S. Freshman, J. A. Burris, and N. Irwin Maxwell.
Environmental Toxicology and Chemistry ETOCDK, Vol. 10, No. 6, p 827-842, June 1991. 5 fig, 8 tab, 21 ref. EPA Cooperative Research Agreement CR814455, and EPA REM III Contract 68-01-7250.

Descriptors: *Baird and McGuire Site, *Data interpretation, *Hazard assessment, *Organic compounds, *Superfund, *Water pollution effects, Bioassay, Chemical analysis, Cochato River, Massachusetts, Species diversity, Taxonomy, Tissue analysis, Toxicity.

Field studies, laboratory experiments and theoretical calculations were used to estimate the ecological risk caused by the release of toxic organic compounds from the Baird and McGuire Superfund hazardous waste site to the Cochato River, a small river in eastern Massachusetts. Results from the field studies, which included: (1) direct measurements of chemical concentrations in sediments and fish tissues; (2) direct measurements of chemical concentrations in dialysis bags filled with hexane and placed in the river; and (3) taxonomic surveys at stations upstream of, adjacent to and downstream of the site, were compared to the results from laboratory tests and computer models. These tests and models included: (1) toxicity bioassays; (2) toxicity quotients based on the US EPA's interim sediment quality criteria; and (3) estimates of bioaccumulation using equilibrium and fugacity models. The resulting patchwork of confirmatory and contradictory findings highlights the limitations of available theoretical and laboratory methods and cautions against reliance on any single method of quantifying stress to aquatic ecosystems. (Author's abstract)
W91-12166

MACROBENTHIC COMMUNITY STRUCTURE BEFORE AND AFTER POLLUTION ABATEMENT IN THE NECHES RIVER ESTUARY (TEXAS).
Lamar Univ., Beaumont, TX. Dept. of Biology.
R. C. Harrel, and M. A. Hall.
Hydrobiologia HYDRB8, Vol. 211, No. 3, p 241-252, March 29, 1991. 8 fig 6 tab, 33 ref.

Descriptors: *Estuaries, *Neches Estuary, *Species diversity, *Texas, *Water pollution control, Benthos, Macroinvertebrates, Navigation channels, Statistics, Water chemistry.

Macrobenthos and physicochemical conditions in the lower 39 km of the Neches River estuary (Texas) were studied from August 1984 to May 1985. The results were compared with data collected in 1971-1972. Between 1972 and 1984 the permitted BOD waste load in the tidal Neches River was reduced from 123,125 kg/d to 8717 kg/d. River discharge and dissolved oxygen concentrations were consistently higher and salinity was lower during the same seasons during the 1984-1985 study. Fifty taxa of macrobenthos were collected in 1971-1972 and 104 taxa were collected in 1984-1985. The numbers of taxa per collection at each station in 1984-1985 were at least twice those found in 1971-1972. Minimum densities in 1984-1985 were much higher than the maximum densities in 1971-1972 at all stations. Patterns of dominance, Sorensen's similarity index and diversity values indicated improved water quality in 1984-1985. Statistical analysis of macrobenthic diversity indicated significant differences between upper estuary and lower estuary stations from 1971-1972. No significant differences were found in 1984-1985. Significant differences in numbers of taxa, macrobenthos densities, and diversity values were found between the two studies. Reductions of waste loads, increased river discharge, and deepening of the navigation channel were among the factors that probably contributed most to the observed changes in macrobenthos community structure. (Author's abstract)
W91-12193

EFFICACY OF SWMM APPLICATION.
Texas Univ. at Dallas, Richardson. Inst. for Environmental Sciences.
For primary bibliographic entry see Field 4A.
W91-12206

GROUND WATER QUALITY AND MANAGEMENT IN MINNESOTA.
Minnesota Dept. of Natural Resources, St. Paul. Div. of Waters.
J. H. Leete.
Journal of the Minnesota Academy of Science JMNAAC, Vol. 56, No. 1, p 34-43, Winter 1991. 8 fig, 43 ref.

Descriptors: *Groundwater, *Groundwater management, *Management planning, *Minnesota, *Regulations, *Water pollution control, *Water quality control, Aquifers, Groundwater pollution, Irrigation, Minnesota Ground Water Protection Strate, Minnesota Water Plan, Policy making, Water pollution.

Minnesota is known for its abundant surface water (lakes, rivers, and streams) and much emphasis is placed on managing these resources. However, groundwater supplies drinking water to about 75% of the state's population and groundwater provides 88% of irrigation water for agriculture. Although surface pollution can affect groundwater, most of Minnesota's groundwater is still available for most uses. There are more than 430 potentially severely contaminated sites and approximately 1400 dumps used for municipal and non-hazardous industrial waste. Most households in Minnesota dispose of sewage on-site in septic systems. Over 175 units and several levels of government are involved in water resource protection and planning. Major agencies involved in this effort include the Environmental Quality Board, Minnesota State Planning Agency, Minnesota Pollution Control Agency, Minnesota Department of Health, Board of Water and Soil Resources, Minnesota Department of Natural Resources, Minnesota Department of Agriculture and the University of Minnesota. Choices are being made about the course of future groundwater quality protection in Minnesota. Efforts are under way to evaluate the vulnerability of aquifers and to assess and inventory potential contamination sources and inappropriate land use practices. Many pertinent policy recommendations are summarized in the Minnesota Ground Water Protection Strategy and the Minnesota Water Plan issued in 1988 and 1990, respectively. (Rochester-PTT)
W91-12209

SOIL CLEAN-UP BY SURFACTANT WASHING. I. LABORATORY RESULTS AND MATHEMATICAL MODELING.
Eckenfelder, Inc., Nashville, TN.
A. N. Clarke, P. D. Plumb, T. K. Subramanyan, and D. J. Wilson.
Separation Science and Technology SSTEDS, Vol. 26, No. 3, p 301-343, March 1991. 17 fig, 23 tab, 21 ref.

Descriptors: *Cleanup operations, *Mathematical models, *Organic compounds, *Polychlorinated biphenyls, *Site remediation, *Soil contamination, *Soil dispersants, *Surfactants, Clay soils, Model studies, Particle size, Separation techniques, Soil types, Solute transport, Waste treatment.

Weathered-in polychlorinated biphenyls (PCBs) were removed from clayey soil by surfactant washing on the bench scale. The efficiency of removal was 99.7%. Spent surfactant was treated for recycle by counter-current liquid-liquid extraction for the removal of nonvolatile contaminants, and by thin film aeration in packed columns for the removal of volatile organics. A correlation of micelle water partition coefficients with octanol/water partition coefficients reported previously was extended to include the pesticides dieldrin and heptachlor (overall correlation coefficient, 0.98). Four mathematical models were derived for the removal of hydrophobic contaminants from soils by surfactant washing for several operations. The first model describes soil surfactant washing in the batch mode by making the assumption that equilibrium, with respect to contaminant transport, is achieved between the contaminated soil and the surfactant contacting it. The second model, derived from the first, assumes that the soil is 'lumpy' and that contaminants must diffuse out from the interior of the lumps to come in contact with the surfactant solution; diffusion kinetics are handled by a lumped parameter method. The third model describes continuous flow surfactant washing of batches of soil, in which diffusion transport may be important. The fourth model describes the operation of a countercurrent flow soil washing column by the inclusion of diffusion transport. Model studies indicated that particle size has a large effect on contaminant removal rates for soil lump sizes > 1 mm; this demonstrates the importance of adequate comminution of the material being washed to the success of the operation. The performance of countercurrent flow soil washing columns depends on the values of the parameters used in the model, necessitating careful pilot-scale studies to determine optimum operating parameters. (MacKeen-PTT)
W91-12278

MICROBIOLOGIC QUALITY OF DRINKING WATER IN NORTH CAROLINA MIGRANT LABOR CAMPS.
North Carolina Univ. at Chapel Hill. School of Public Health.
S. Ciesielski, T. Handzel, and M. Sobsey.
American Journal of Public Health AJHEAA, Vol. 81, No. 6, p 762-764, June 1991. 2 tab, 16 ref.

Descriptors: *Drinking water, *Microbiological studies, *North Carolina, *Public health, *Water quality, Domestic water, Fecal coliforms.

A two-year study of drinking water in 27 randomly selected North Carolina migrant labor camps yielded a total and fecal coliform prevalence of 44% and 26%, respectively in 1988, and similar but higher prevalence in 1989. Preoccupancy testing by county sanitarians had found virtually no total coliform contamination. These findings suggest that a potential source of contamination existed and that current testing protocols which rely on preoccupancy testing may be inadequate. (Author's abstract)
W91-12285

RISK ASSESSMENT WITH LOWER PROBABILITIES: APPLICATION TO TOXIC WASTES.
Oak Ridge National Lab., TN.
B. Tonn, and C. Wagner.
Journal of Environmental Systems JEVSBH, Vol. 20, No. 2, p 169-178, 1990/1. 2 tab, 10 ref.

Descriptors: *Optimization, *Risk assessment, *Statistical analysis, *Toxic wastes, *Waste disposal, Conditionalization, Performance evaluation, Probabilistic process, Public policy, Waste management.

Traditional approaches to the quantitative analysis of uncertainty employ probabilities, although evidence to support the principled assessment of such additive measures is often lacking. In particular, both optimization and conditionalization can be successfully pursued when uncertainties are assessed, in terms of lower probabilities with surprisingly weak structural properties. Concrete applications of optimization and conditionalization are applied to some problems connected with a toxic waste dump. However, the potential applications of these methods are very extensive, including problems associated with power plant reliability, human exposure to carcinogens, global climate change, and many types of policy analysis. (Lantz-PTT)
W91-12288

MULTIVARIATE TESTS FOR TREND IN WATER QUALITY.
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
J. C. Loftis, C. H. Taylor, and P. L. Chapman.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1419-1429, July 1991. 16 fig, 1 tab, 24 ref. Colorado Experiment Station Project 349 and EPA Contract 68-03-3439.

Descriptors: *Multivariate analysis, *Statistical methods, *Trend analysis, *Water quality, *Water quality trends, Comparison studies, Data interpretation, Mathematical analysis, Mathematical studies, Statistical analysis.

Both parametric and nonparametric approaches to multivariate testing are reviewed and compared using synthetic data. Two of the alternatives, the Sen and Puri (SP) and MANOVA tests, are based on linear models. The SP test is an aligned rank order method of estimation and testing for linear models; it is asymptotically distribution free. Three multivariate extensions of the Mann-Kendall were

also considered: the covariance sum (CS), covariance inversion (CI), and covariance eigenvalue (CE) tests, along with 'modified' versions of the CI and CE tests which assume independence across seasons. The CI, CE and CS tests account for between-season correlation, providing a means to at least partially account for serial correlation. For independent observations, the SP test was robust and efficient for 10-year and 20-year data records. SP performed as well as MANOVA for normal data and as well as the Mann-Kendall based tests, MCI and MCE, for log-normal data. Of the latter, MCI is the logical choice since it is simpler than MCE and has a slight edge in overall power performance. For serially correlated series, the CE test appears to be the best choice all around, although its power advantage over CI disappeared for 20-year data records. The CE and CI tests were conservative under the correlation structures studies. (Lantz-PTT)
W91-12319

EFFICIENT AND ACCURATE FRONT TRACKING FOR TWO-DIMENSIONAL GROUNDWATER FLOW MODELS.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5B.
W91-12324

STATISTICAL ESTIMATION AND INTERPRETATION OF TRENDS IN WATER QUALITY TIME SERIES.
Lund Univ. (Sweden). Dept. of Mathematical Statistics.
L. Zetterqvist.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1637-1648, July 1991. 7 fig, 4 tab, 32 ref.

Descriptors: *Ljungbyan River, *Statistical analysis, *Statistics, *Time series analysis, *Trend analysis, *Water quality, Data interpretation, Hydrologic models, Model studies, Noise, Phosphorus, Seasonal variation, Statistical models, Sweden.

Three approaches to trend analysis of water quality times series are discussed: (1) seasonal model, with a test for trend based on ranks of observations; (2) transfer function noise model, in which covariate series may be included by means of transfer functions, with the remaining noise modeled as a seasonal autoregressive moving average process; and (3) component model, with the noise decomposed into series which describe trends, and irregular and seasonal variation. Models are studied with regard to their ability to include covariate series, possibility of interpretation of trends, treatment of seasonal variation and serial dependence, and robustness for outliers. The author considers the component model to be the most realistic and the most informative of the three approaches. The models were then applied to a series of monthly phosphorus concentrations in the Ljungbyan River in Southern Sweden. (Author's abstract)
W91-12338

ESTIMATING CHANGES IN RECREATIONAL FISHING PARTICIPATION FROM NATIONAL WATER QUALITY POLICIES.
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 6D.
W91-12349

STUDIES IN BATCH AND CONTINUOUS SOLVENT SUBLATION. III. SOLUBILITY OF PENTACHLOROPHENOL IN ALCOHOL-WATER MIXTURES AND ITS EFFECTS ON SOLVENT SUBLATION.
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W91-12409

GROWTH OF BLUE-GREEN ALGAE IN THE SAIDENBACH RESERVOIR AND ITS RELATIONSHIP TO THE SILICON BUDGET.
Sachsische Akademie der Wissenschaften zu Leipzig, Arbeitsgruppe 'Limnologie von Talsperren,' Neunzehnhain, Germany.
For primary bibliographic entry see Field 2H.
W91-12446

DISTRIBUTION AND SEASONAL ABUNDANCE OF BENTHIC MACROINVERTEBRATES IN LAKE NAINI TAL, U.P., INDIA.
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W91-12447

TRIMETHYLPHENYLAMMONIUM-SMECTITE AS AN EFFECTIVE ADSORBENT OF WATER SOLUBLE AROMATIC HYDROCARBONS.
Michigan State Univ., East Lansing.
For primary bibliographic entry see Field 5E.
W91-12451

MANAGING SHRIMP POND WATER TO REDUCE DISCHARGE PROBLEMS.
Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
J. K. Wang.
Aquacultural Engineering AQEND6, Vol. 9, No. 1, p 61-73, 1990. 1 tab, 33 ref. Department of Agriculture Cooperative Agreement No. 88-34167-4060.

Descriptors: *Aquaculture, *Flushing, *Shrimp, *Wastewater treatment, *Water quality management, *Water reuse, Algae, Bivalves, Economic aspects, Oysters, Recirculated water, Suspended solids, Water quality.

The excessive feed used in intensive and semi-intensive shrimp production systems is the basic cause for shrimp pond water quality problems, which are currently resolved by flushing. Flushing is not only wasteful of water resources, but also creates effluent discharge problems. The two major contributors to pond water quality problems are the over-population of algae and the presence of suspended solids. Algae can be removed by bivalves and suspended solids can be removed by sedimentation devices. With algae and suspended solids removed, a large portion of the water can be returned to the shrimp pond. The feasibility of this type of shrimp/oyster co-production system is demonstrated using shrimp pond water to feed oysters, while using oysters to remove small suspended solids (including algae) from the water and sedimentation devices to remove the larger suspended solid particles. The production process produces two high-priced products while sharing many of the production inputs, such as feed, water, energy and ponds. (Author's abstract)
W91-12493

CALIBRATION AND VALIDATION OF TAP, AN AQUACULTURE POND WATER QUALITY MODEL.
California Univ., Davis. Dept. of Agricultural Engineering.
R. H. Piedrahita.
Aquacultural Engineering AQEND6, Vol. 9, No. 2, p 75-96, 1990. 8 fig, 3 tab, 19 ref. U.S. Agency for International Development Grant No. DAN-4023-G-SS-7066-00.

Descriptors: *Aquaculture, *Calibrations, *Model studies, *The Aquaculture Pond Model, *Water quality, Biomass, Chlorophyll, Dissolved solids, Fish, Hydrogen ion concentration, Nutrients, Performance evaluation, Phytoplankton, Secchi disks, Simulation analysis, Water temperature, Zooplankton.

A computer model of water quality in aquaculture ponds (The Aquaculture Pond model, TAP) was run, and data were obtained from five research sites around the world. Calibration of the model was carried out by adjusting selected rate coefficients to improve the fit between simulated and measured values for one pond at one site on one date. Data requirements for the model were not completely satisfied with the data available in the database, and certain assumptions and approximations had to be made. In particular, measurements of temperature, solar radiation and wind velocity had to be modified to yield hourly values for use as inputs to the model. Diel temperature measurements obtained at the three depths were averaged and interpolated to obtain hourly values. Given the limited data available, wind velocity was assumed to be uniform during the day. Hourly values of solar radiation were obtained by calculating the theoretical light energy reaching the surface of the earth in the absence of clouds, and comparing it to the measured value to obtain a /cloud' factor. Measurements of nutrient concentration (total ammonia nitrogen, combined nitrite and nitrate nitrogen, and inorganic phosphorus) were used directly as input values for the model. Total carbonate carbon was calculated from measured values of pH, alkalinity and temperature for use as an input to the model. Phytoplankton biomass was not measured directly and the measured values of chlorophyll were used to arrive at an estimate of algal biomass. Zooplankton biomass measurements were not available, and a value of 1.0 g/cu m was used for all the simulations. Fish biomass was calculated from estimates of fish density and of individual fish mass. Density was estimated from the number of fish stocked and the recorded number of mortalities. Initial conditions in the ponds simulated differed considerably between sites and between treatments at a given site. In particular, parameters such as alkalinity, secchi disk depth, chlorophyll and dissolved oxygen tended to vary between sites and between treatments. Possible sources of this discrepancy are assumptions of: fully mixed conditions; uniform wind and cloud cover over the diel cycle; a lack of information on dissolved organic matter; and, a constant ratio of chlorophyll to phytoplankton biomass. (Lantz-PTT)
W91-12494

MONITORING GROUNDWATER AND WELL WATER FOR CROP PROTECTION CHEMICALS.
Monsanto Co., St. Louis, MO.
For primary bibliographic entry see Field 5A.
W91-12536

WATERMATEX '91.
For primary bibliographic entry see Field 6A.
W91-12568

APPLICATION OF SYSTEMS ANALYSIS IN WATER POLLUTION CONTROL: PERSPECTIVES FOR CENTRAL AND EASTERN EUROPE.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 6A.
W91-12578

WATER QUALITY MANAGEMENT OF KEELUNG RIVER, NORTHERN TAIWAN.
National Taiwan Univ., Taipei. Inst. of Environmental Engieering.
K. S. L. Lo, and H. H. Chen.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 109-116, 1991. 3 fig, 6 tab, 6 ref. National Science Council of Taiwan, Contract No. NSC79-0421-E002-28Z.

Descriptors: *Keelung River, *Management planning, *Model studies, *Water pollution control, *Water quality management, Biochemical oxygen demand, Data interpretation, Dissolved oxygen, Flushing, Nitrification, Pollution load, Taiwan, Waste load allocation, Water quality.

The Keelung River, one of the major tributaries of the Tansui River in Northern Taiwan, has been heavily polluted by municipal and industrial wastewater. As part of an integrated study on pollution control and planning of the Keelung River, water quality modeling and waste load allocations were conducted in order to provide information on the level of wastewater treatment required to meet the water quality standards of the Keelung River. The water quality model used for the river was a modified version of the QUAL2E

computer program of the U.S. Environmental Protection Agency. The Keelung River was segmented into 13 reaches according to hydrologic and hydraulic properties, sites of point sources and tributaries, and biochemical characteristics. The model was calibrated and tested 10 times based on field water quality data collected over a 2 year period. Most results confirmed that a zero-order kinetic formulation of carbonaceous biochemical oxygen demand (CBOD) decomposition was better than that of a first-order reaction in the anaerobic river reaches. In addition, nitrification was determined to be an important factor in waste load allocation analysis. However, it was found that the amount of removed waste would be underestimated because the nitrification process in the Keelung River is not accounted for in the model. To meet the water quality standards of the Keelung River, it was suggested that a great amount of benthic oxygen demand be removed in addition to the secondary treatment of all point sources at downstream reaches. (See also W91-12568) (Korn-PTT)
W91-12581

MANAGEMENT OF A COMPLEX WATER SUPPLY NETWORK FOR THE STABILIZATION OF AQUATIC HABITAT.
F. Cubillo.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 117-124, 1991. 4 fig, 10 ref.

Descriptors: *Evaluation, *Madrid, *Management planning, *Water pollution control, *Water resources management, *Water supply, *Water supply systems, Canal de Isabel II, Computer models, Mathematical models, Model studies, Multipurpose reservoirs, Spain, Water quality, Water use.

A study of the needs and feasibility of the maintenance of the flow regimes established in the river reaches located downstream from dams is an issue which is appearing often as part of the basic considerations for hydraulic and environmental planning, as well as for the exploitation of hydraulic resources. The management of a complex system of reservoirs, rivers and waste treatment plants, such as in the case of the Canal de Isabel II of Madrid, regards the needs and feasibility factors as part of the overall hydraulic planning program of its watersheds. The Canal de Isabel II, the water supply company for the Madrid region of Spain, manages a complex reservoir and water distribution network (10 rivers) and waste treatment system. The complexity of Madrid's hydraulic system and the influence that erroneous conclusions could exert upon determining the discharge regimes made it necessary to integrate a wide range of mathematical models for water quality, resource management, and instream flow, so that ultimately, each alternative could be contrasted with its corresponding economic and social costs. The study concluded that maintaining aquatic habitats in one of the rivers was impossible, and that two of the rivers would incur very high costs. Nevertheless, the maintenance of aquatic habitats in seven of the major rivers is possible at a reasonable cost, if the operational rules for the water supply system are modified. It is important to note, however, that these conclusions were obtained as a result of dealing with the general and average conditions only, of the hydrologic and hydraulic system of supply to Madrid. (See also W91-12568) (Korn-PTT)
W91-12582

DEVELOPMENT OF A PERSONAL COMPUTER-BASED SYSTEM TO SUPPORT BASIN-WIDE MANAGEMENT OF WATER QUALITY IN LAKES AND RIVERS.
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 7C.
W91-12583

MODELING EFFECTS OF TIDAL BARRIER CLOSURE OF VENICE LAGOON.
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6G.
W91-12586

OPERATIONS AND CONTROL IN WASTEWATER TREATMENT--SOME SWEDISH EXPERIENCES.
Lund Univ. (Sweden). Dept. of Industrial Automation.
For primary bibliographic entry see Field 5D.
W91-12592

DEVELOPMENT OF A CONTROL STRATEGY TO REDUCE COMBINED SEWERAGE OVERFLOWS: THE CASE OF BREMEN-LEFT OF THE WESER.
Hanover Univ. (Germany, F.R.). Inst. fuer Verkehrswirtschaft.
A. Khelil, and S. Schneider.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 201-208, 1991. 7 fig, 5 ref. German Ministry for Research and Technology Project No. 02-WA86470.

Descriptors: *Bremen, *Combined sewer overflows, *Control systems, *Evaluation, *Expert systems, *Operating policies, *Urban drainage, *Urban hydrology, *Water pollution control, *Water quality management, Germany, Monitoring, Simulation analysis.

In recent years, the population and authorities of the German city of Bremen have become concerned with water pollution resulting from combined sewage overflows. When the city of Bremen decided to renew the on-line survey and monitoring system of its Urban Drainage System (UDS), the determination of on-line strategies to operate the pumps was important. Various methods and tools were developed to investigate the possibility of reducing the pollution loads through improved control strategies. The use of a Real-Time Control (RTC) option was examined as a means of better exploiting the existing storage capacity of the UDS. The current surveying and monitoring system at Bremen provides the following information: (1) measurement of rainfall intensities, (2) water levels, (3) pumping rates, (4) flow rates, and (5) energy consumption. Experience with RTC has lead to the progressive elaboration of standard control instructions which may be expressed as control rules. In order to systematically analyze and develop control strategies, an optimization module or an expert system was considered. It was necessary to simulate the flow processes within the network as well as simulate the decision process through an expert system. Results of the study revealed that a reduction of discharge quantities was possible without altering the flood frequency. However, systematic utilization of the in-line storage capacity caused an increase in the frequency of pressure flows. Whether this degradation of the drainage facility will be accepted in order to achieve better environmental protection is a political decision. (See also W91-12568) (Korn-PTT)
W91-12593

NETWORK ALGORITHM FOR THE OPTIMUM OPERATION OF URBAN DRAINAGE SYSTEMS.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
K. Neugebauer, W. Schilling, and J. Weiss.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 209-216, 1991. 4 fig, 1 tab, 4 ref.

Descriptors: *Algorithms, *Combined sewer overflows, *Combined sewers, *Computer programs, *Optimization, *Urban drainage, *Urban hydrology, Computers, Control systems, Data interpretation, Flooding, Networks, Real time control.

Most urban drainage systems in larger cities are combined sewer systems (CSS) in which both sanitary sewage and storm runoff is collected together in a single sewer pipe. A necessary condition for the successful operation of a sewer system in real time, is an efficient control strategy that would yield good performance with less damage, simply by better use of the existing system capacity. Consequently, the optimum strategy is often created that will yield minimum volumes of flooding and overflow. An investigation was undertaken to evaluate the routing of sewage through a combined sewer by means of a real-time control system. The task was formulated as a mathematical network optimization problem, with the sewer system simplified to be a set of linearly operating nodes and arcs. The outcome of the tests indicated that the results obtained were comparable to linear programming solutions but much larger systems could be handled. The algorithm was fast enough to be applied to real world sewer systems using an AT-personal computer. Since the efficiency of a sewer system can only be expressed in statistical terms (i.e., flooding frequency, overflow frequency), the algorithm might be useful for some form of 'long-term optimization' (e.g., for the largest storms of few decades), thereby obtaining a statistically based evaluation of an expected system performance. (See also W91-12568) (Author's abstract)
W91-12594

DETENTION OF SANITARY SEWAGE AS A METHOD TO REDUCE COMBINED SEWER OVERFLOW POLLUTION LOADS.
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft.
D. T. Kollatsch, and J. Bunzel.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 217-224, 1991. 5 fig, 4 ref. Deutsche Forschungsgesellschaft Project No. DFG Si 242/11.

Descriptors: *Combined sewer overflows, *Detention reservoirs, *Model studies, *Simulation analysis, *Water pollution control, *Water quality management, Computer models, Control systems, Data interpretation, Evaluation, Operating policies, Pollution load, Sanitary wastewater.

Sanitary sewage creates the basic and most important pollution load diverted to receiving waters during combined sewer overflow (CSO). To reduce overflow pollution loads, it was proposed that wastewater be stored in sanitary sewage detention tanks (SST). The efficiency of SSTs was examined by continuous simulation of rainfall, stormflow transport and pollutant transport processes during a long-term simulation of a catchment area located near the city of Essen in Germany. A modified version of the KOSIM model was used to model real-time control (RTC) and the operational effects on SSTs. In the simulation, four subcatchments were drained by separate system; therefore four SSTs had to be controlled. Results of the study indicated that the reduction of pollution load through detention in SSTs was not satisfactory for real-time control. In the long-term simulation, only 20% of the pollution load was detained in SSTs, and came from separate CSO systems; Another 6% was kept in the combined sewage retention tank (CSRT). For higher efficiency, it was recommended that the SSTs be filled and emptied by pumps or gates and operated by control devices. Global control strategies were installed to account for global measurement information in the control decisions. Efficiency could be upgraded to $> 50\%$ of the retained CSO pollution load, compared with the total CSO load, without any sanitation. (See also W91-12568) (Korn-PTT)
W91-12595

OPERATIONAL WATER QUALITY MANAGEMENT: TRANSIENT EVENTS AND SEASONAL VARIABILITY.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. B. Beck, A. J. Adeloye, B. A. Finney, and P. Lessard.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 257-265, 1991. 2 fig, 42 ref.

Descriptors: *Model studies, *Storm-overflow sewers, *Urban hydrology, *Wastewater facilities, *Water pollution control, *Water quality, *Water quality management, Ammonium, Bedford Ouse River, Cam River, Case studies, Control systems, England, Mathematical models, Seasonal variation, Storm water, Toxicity, Watershed management.

The practical urgency of addressing problems of the transient pollution of receiving waters by stormwater overflows has done much to assist in dismantling the restrictive assumption of a steady-state that has dominated analyses of water quality management. However, there are still misconceptions about the complexity and data requirements of dynamic mathematical models, and about the capacity to exercise operational control over the performance of a wastewater treatment plant. There is a crucial need for servicing the development of models of transient behavior with appropriately designed, specialized, monitoring exercises. Models describing the dynamic behavior of the unit processes of wastewater treatment and receiving water (river) response were applied to two case studies. Results from a case study based on the River Cam in eastern England illustrate the impacts of stormwater discharges on the receiving water body as a function of various treatment plant designs and operational strategies. Results are also presented for a second case study, basedon the Bedford Ouse River in eastern England. In this case, a dynamic model of receiving water quality was used to assess the scope for seasonally varying policies for the treatment of ammonium, subject to fish toxicity and in-plant oxygenation requirements. Further studies exploring the interactions between seasonally varying conditions and transient pollution events are currently in progress. (See also W91-12568) (Korn-PTT)
W91-12599

CORMIX: AN EXPERT SYSTEM FOR MIXING ZONE ANALYSIS.
Cornell Univ., Ithaca, NY. DeFrees Hydraulics Lab.
For primary bibliographic entry see Field 5B.
W91-12600

PICTORIAL SIMULATION APPLIED TO WATER QUALITY MODELING.
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
A. S. Camara, F. C. Ferreira, J. E. Fialho, and E. Nobre.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 275-281, 1991. 5 fig, 1 tab, 15 ref.

Descriptors: *Computer models, *Data interpretation, *Graphical methods, *Model studies, *Pictorial models, *Water pollution control, *Water quality management, Computer programs, Data processing, Oil spills, Simulation analysis, Stabilization ponds, Water quality.

Although it has been shown that numerical representations are adequate for specific data element retrieval, pictorial representations, including a more holistic view of data, are often suitable whenever spatial relationships are involved. Most water quality management problems have an important spatial dimension and many numerical models present pictorial represe.ntations at the input/output stages. However, the operations included in these models remain strictly numerical. An investigation was undertaken to study the manipulation of pictorial representations with pictorial operations. The simulation methodology relied on pictorial operations with entities developed to test these assumptions. These entities were defined by their shape, size, color, and position, with operators that included reproduction (copy of a pictorial entity), mutation (expansion, rotation, translation, and change in color), fertile encounters (intersection, reunion), and sterile encounters (absorption). This type of pictorial simulation was successfully applied to two water quality management problems: an oil spill accident and the ecology of a waste stabilization pond. The applications illustrated the pictorial simulation value in the communication of water quality problems. Future developments in the pictorial simulation of cellular automata suggest that pictorial cellular automata model may be a significant improvement over the numerical water quality models. (See also W91-12568) (Korn-PTT)
W91-12601

DBAPE--A DATABASE AND MODEL PARAMETER ANALYSIS SYSTEM FOR AGRICULTURAL SOILS TO SUPPORT WATER QUALITY MANAGEMENT.
AQUA TERRA Consultants, Decatur, GA.
For primary bibliographic entry see Field 7C.
W91-12608

ASSESSMENT OF EUTROPHICATION CONTROL PROGRAMS USING AN ECOLOGICAL MODEL FOR A DIMICTIC LAKE.
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
M. Hosomi, M. Okada, and R. Sudo.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 339-348, 1991. 6 fig, 1 tab, 18 ref.

Descriptors: *Data interpretation, *Eutrophication, *Lake Yunoko, *Limnology, *Model studies, *Seasonal variation, *Water pollution control, *Water quality management, Artificial aeration/circulation, Bottom sediments, Chlorophyll a, Cycling nutrients, Dissolved oxygen, Ecosystems, Eutrophic lakes, Evaluation, Japan, Nutrients, Phosphorus, Sediment dredging, Sediment-water interfaces.

An ecological model of Lake Yunoko, a dimictic lake, was developed to assess various programs for eutrophication control with special emphasis on managing the bottom sediment. A multi-component dynamic model for nutrients in the bottom sediment-water system was incorporated into an ecological model. Good agreement was noted between the model calculations and observed nutrients, chlorophyll-a, and dissolved oxygen concentrations in the water and nutrient concentrations in the bottom sediment. The effectiveness of eutrophication control programs on chlorophyll-a concentrations in the surface water, and dissolved oxygen and PO4-P concentrations in the bottom water, were assessed using the calibrated model. Sediment dredging decreased the nutrient flux from the bottom sediment. As a result, the peak chlorophyll-a concentration in the surface water, during the autumn circulation period, did not occur. However, sediment dredging did not effect the reduction in the nutrient release flux after 4 years as compared with the control simulation. The depletion of dissolved oxygen in the bottom water during the summer stagnation period was barely restored by dredging alone. Artificial circulation increased dissolved oxygen in the bottom waters by 7.2 mg/L throughout the year, whereas chlorophyll-a concentrations in the surface water decreased slightly when compared with the control simulation. In the case of a 50% reduction of external phosphorus loading from the wastewater treatment facility, the annual average chlorophyll-a concentration in the surface water decreased to 79% of that of the control simulation for the fourth year. (See also W91-12568) (Korn-PTT)
W91-12609

RISK MANAGEMENT FOR NITRATE-CONTAMINATED GROUNDWATER SUPPLIES.
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
M. F. Dahab, and I. Bogardi.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-192427. Price codes: A14 in paper copy, A02 in microfiche. Final Report, November 1990. 290p, 56 fig, 59 tab, 222 ref, 4 append. USGS Contract No. 14-08-0001-G1631.

Descriptors: *Cost analysis, *Groundwater, *Nitrates, *Nitrogen, *Risk management, *Systems analysis, Cost comparison, Fuzzy set theory, Groundwater resources, Uncertainty, Water pollution control, Water supply, Water treatment.

To reduce nitrate risk from groundwater supplies, several strategies were developed based on an acceptable level of human health risk, the reasonableness of nitrate control cost, and the technical feasibility of nitrate control methods. While high cost strategies may provide a high degree of human health risk protection, low cost ones may not provide adequate protection. Therefore, the objectives of risk reduction and cost are in conflict with each other. The ultimate goal of the nitrate risk management is to determine, under a great deal of uncertainty, which strategy 'best' satisfies the human health risk reduction and nitrate control cost criteria. The methodology addresses specific, yet common, cases of groundwater contamination in the western U.S. New systems analysis tools, a combined probabilistic and fuzzy set approach, are used to address uncertainties common to risk management. In addition to addressing different strategies for nitrate control, different nitrate inputs (point and non-point sources) also were considered in the development of this methodology. (USGS)
W91-12634

IMPORTANCE OF DENITRIFICATION TO THE EFFICIENCY OF WASTEWATER TREATMENT IN FORESTED WETLANDS.
University of Southwestern Louisiana, Lafayette. Dept. of Biology.
For primary bibliographic entry see Field 5D.
W91-12638

WATER QUALITY TRAINING PROGRAM FOR THE LOUISIANA COOPERATIVE EXTENSION SERVICES.
Louisiana State Univ., Baton Rouge. Cooperative Extension Service.
For primary bibliographic entry see Field 10D.
W91-12642

EUTROPHICATION ABATEMENT PROGRAMME FOR THREE NORTH HOLLAND VECHT LAKES.
Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
R. M. M. Roijackers, and P. J. T. Verstraelen.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 768-772, March 1991. 1 fig, 4 tab, 8 ref.

Descriptors: *Ankeveen Lake, *Eutrophic lakes, *Kortenhoef Lake, *Lake restoration, *The Netherlands, Dredging, Eutrophication, Groundwater, Nutrient concentrations, Path of pollutants, Polders, Vecht River, Wastewater pollution, Water balance, Water level, Water pollution, Water resources management.

Since the end of the last century, the water supply of the shallow lakes Kortenhoef and Ankeveen has changed drastically. Reclamation of the deep polder Horstermeer and groundwater extraction for drinking water have greatly influenced regional groundwater resources making lakes Kortenhoef and Ankeveen dependent on water supplied from the Vecht River and the 's Graveland Canal. The water balance condition of lake sediments, and nutrient budgets were investigated and a eutrophication abatement program was established in this area. Water balances were calculated for the average wet season (September to April) and the average dry season (May to August), and were found to be closely related to the location of the lakes with respect to the deep polder Horstermeer, as well as to the maintenance of a constant water level in the polders. Since nitrogen and phosphorus are the principal nutrients responsible for eutrophication of the lakes, the lake management strategy included: (1) a diversion of all sewage discharges; (2) connecting all remaining untreated wastewater discharges to the sewer system; (3) an investigation of the feasibility of fluctuating the water levels in Lake Hollands Ankeveen; (4) an investigation of potential alternative supplies including the necessity of additional water treatment; and (5) an investigation of the potential nutrient release from lake sediments. Management goals, including the conservation and restoration of original ecosystem, led to restoration and conservation proposals involving a great deal of other authorities and interests and revealing the imperfection of Dutch water management organization. Plans to pump seepage water from the polder Horstermeer into the lakes are in a phase of construction specifications and dredging measures are being prepared. (Brunone-PTT)
W91-12675

CHANGES IN COMMUNITY STRUCTURE AND GROWTH LIMITATION OF PHYTOPLANKTON DUE TO TOP-DOWN FOOD-WEB MANIPULATION.
Agricultural Univ., Wageningen (Netherlands). Dept. of Nature Conservation.
E. van Donk.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 773-778, March 1991. 4 fig, 1 tab, 21 ref.

Descriptors: *Algal growth, *Eutrophic lakes, *Food chains, *Lake Zwemlust, *Lake restoration, *Limnology, *Phytoplankton, *Species composition, Algal blooms, Aquatic macrophytes, Biomass, Chlorophyta, Fisheries, Nutrients, Phosphorus, The Netherlands, Water quality, Zooplankton.

Lake Zwemlust is a small, shallow lake, located in the province of Utrecht, the Netherlands, which is replenished by nutrient-rich seepage water from the Vecht River and by precipitation. The lake has no surface inflows or outflows. In March 1987, the lake was drained by pumping out the water, and the entire fish community was removed by seining and electrofishing. After the lake was refilled, by seepage, it was restocked with fish from a hatchery. To assess the factors limiting the growth of phytoplankton in the lake, natural community enrichment bioassays were performed for 6 days at in situ temperature and natural light-dark cycle. In March 1989, chlorophyll a concentrations reached 150 microg/L due to a chlorophyte bloom. The nitrate and ammonium concentrations declined to near detection levels in spring and summer, in contrast with the phosphorus concentrations. Lake zooplankton biomass and large-sized daphnids increased, but the phytoplankton biomass drastically decreased. Submerged macrophytes increased, due to an improved underwater light climate. This submerged vegetation, accumulating large quantities of nitrogen, probably contributed to the low nitrogen concentrations in the water and nitrogen limitation of the phytoplankton in 1988 and 1989. From the enrichment bioassays conducted after food web manipulations, the growth of phytoplankton appears to be regulated by more than one factor, operating simultaneously or successively. In Lake Zwemlust, fish stock management positively influenced the water quality. (Brunone-PTT)
W91-12676

IRREGULAR BIOMASS RESPONSE IN RECOVERING PREALPINE LAKES.
Bodensee-Wasserversorgung, Ueberlingen-Suessenmuehl (Germany, F.R.). Water Control and Research Lab.
For primary bibliographic entry see Field 2H.
W91-12683

LONG-TERM CHANGES OF CRUSTACEAN PLANKTON DURING SUCCESSFUL RESTORATION OF LAKE SCHLACHTENSEE (BERLIN-WEST).
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
S. Ewald.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 866-872, March 1991. 4 fig, 17 ref. Berlin-Forschung of the Free University of Berlin Grant No. 6/81.

Descriptors: *Crustaceans, *Lake restoration, *Limnology, *Plankton, *Schlachtensee, Abundance, Eutrophication, Feeding rates, Fish predation, Germany, Monitoring, Oligotrophy, Phytoplankton, Population density, Population dynamics, Species composition, Waterfleas, Zooplankton.

To document long-term responses of the primary consumers to trophic changes in Lake Schlachtensee, Germany during successful restoration, a long-term investigation of planktonic crustaceans was carried out from 1982 to 1989. This seven year monitoring was expected to resolve two points: (1) how the crustacean stock reacts to changing trophic states; and (2) whether these changes are the reverse of changes observed during the process of eutrophication. Zooplankton was collected at an 8 m deep site, situated in the deeper southern basin, from January 1982 to June 1983, from May to December 1985, and from May 1987 to July 1989, at approximately one-week to two-week intervals during the vegetation period, and monthly during the cold season. During the first three years of restoration, Lake Schachtensee showed all of the characteristics typical for a highly eutrophic lake. Secchi depths were low, ranging from 0.35 m in summer to 2.4 m at the end of May 1982, due to persistently high phytoplankton densities. The crustacean community structure shifted from small mesh filter-feeders to larger coarse filter-feeders, due exclusively to the considerable changes in cladoceran numbers and composition; the largest response shown by Bosmina. The ratio of yearly fluctuation in crustacean abundance decreased from 1:19 in 1982 down to an average value of 1:9 after 1985. The amplitude height of this fluctuation of crustacean densities was positively correlated to the trophic level of the lake, indicating a diminished trophic state in Lake Schlachtensee since 1985. A significant decrease in the crustacean spring maximum during restoration resulted in a smoothed pattern of seasonal distribution. This seasonal pattern of crustacean development indicates an intermediate status between eutrophic and oligotrophic states of the lake. Further development should be observed, and supported by a reduction of nutrients and planktivorous fish stock. (Brunone-PTT)
W91-12695

NUTRIENT BALANCES AND PHYTOPLANKTON DYNAMICS IN SCHLACHTENSEE DURING OLIGOTROPHICATION.
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 2H.
W91-12696

REACTION OF PHYTOPLANKTON COMMUNITY ON HYPOLIMNIC AERATION.
Polish Academy of Sciences, Lomianki. Dept. of Hydrobiology.
A. T. Simm.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 901-904, March 1991. 4 fig, 7 ref.

Descriptors: *Aeration, *Algal growth, *Chlorophyta, *Hypolimnic aeration, *Hypolimnion, *Lake Jaroszewskie, *Lake Lidzbarskie, *Lake Zamkowe, *Lake restoration, *Limnology, *Phytoplankton, *Species composition, *Water pollution treatment, Ecosystems, Population dynamics.

The use of hypolimnic aeration as a method to restore lakes was investigated in four lakes in Poland. During summer stagnation, aeration of the hypolimnion causes an increase in chlorococcal biomass, but does not limit the growth of Ceratium sp. These two phytoplankton groups become more abundant with the disappearance of filamentous blue-green algae. This phenomena was observed in Kierskie, Jaroszewskie, and Zamkowe lakes. In Lidzbarskie Lake polluted river water destabilizes the lake ecosystem and causes a specific phytoplankton composition, i.e. centric diatoms and Chlorooccales dominate. Hypolimnion aeration seems to be a fast-working method, which stops large blooms of blue-greens and allows for recolonization of deep profundal zoobenthos, but does not secure permanent restoration of the lake ecosystem. Stopping aeration reversed the lake to the previous state. (Brunone-PTT)
W91-12702

PLANKTON SUCCESSION IN LAKE SEMPACH, LAKE HALLWIL AND LAKE BALDEGG BEFORE AND DURING INTERNAL RESTORATION MEASURES.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
H. R. Burgi, and P. Stadelmann.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 931-936, March 1991. 8 fig, 1 tab, 6 ref.

Descriptors: *Algal blooms, *Baldegger See, *Hallwiler See, *Lake Sempach, *Lake restoration, *Limnology, *Oxygenation, *Phytoplankton, *Succession, *Switzerland, *Water pollution treatment, *Zooplankton, Aerobic conditions, Algal growth, Biomass, Chlorophyta, Cyanophyta, Eutrophic lakes, Feeding rates, Fishkill, Hypolimnion, Population density, Primary productivity, Species composition, Water chemistry.

Before and during lake restoration measures in three Swiss lakes (oxygenation of the hypolimnion during summer and artificial mixing during winter) intensive physical and chemical investigations were accompanied by phytoplankton and zooplankton counts. By means of these biological investigations, various events (blooms of blue-green algae, fish kills) could subsequently be explained. The three lakes are still eutrophic, as shown by the phytoplankton biomass and composition, even though the oxygen conditions in the hypolimnion improved significantly (aerobic conditions over the whole year). In the last thirty years, the composition of plankton changed significantly, to green and blue-green algae. The increase in algal production also had an effect on the zooplankton: the populations also increased, and caused clear water stages by excessive grazing of the algae in May and June. These investigations demonstrate how important biological monitoring is during internal lake restoration programs. (Brunone-PTT)
W91-12710

CONSEQUENCES OF WATER OLIGOTROPHICATION ON MACROPHYTIC VEGETATION OF SWISS LAKES.
Geneva Univ. (Switzerland). Unite de Biologie Aquatique.
J. B. Lachavanne, R. Juge, and J. Perfetta.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 943-948, March 1991. 2 fig, 2 tab, 27 ref.

Descriptors: *Aquatic plants, *Greifensee, *Hallwiler See, *Lake Sempach, *Lake restoration, *Limnology, *Nutrients, *Oligotrophic lakes, *Pfaeffiker See, *Phosphorus removal, *Water pollution control, Population density, Regression analysis, Switzerland, Trophic status, Water quality.

Macrophyte vegetation was compared in four Swiss plateau lakes undergoing oligotrophication, which were studied during a 10 year period (1977/1978 to 1987). The lakes are relatively deep and, in three of them (Greifen, Pfaffikon, and Hallwil Lakes), the average phosphorus concentration has fallen markedly in the years between the two studies; the fourth lake (Lake Sempach) has not shown any marked trophic change over the ten year period. The biological signs of lake water oligotrophication have been tested by a comparative diachronic analysis of aquatic vegetation in three lakes undergoing oligotrophication versus that of a lake in which the trophic level is more or less stable. Aquatic vegetation abundance has changed considerably in lakes where the trophic level has decreased. The submerged macrophytes show considerably greater abundance in the lakes undergoing oligotrophication (with phosphorus concentrations lower than 200 microg/L). Changes in emergent and floating-leaved plants are less significant and constant. A clear regression exists in Lake Greifen and Lake Pfaffikon with a loss of colonized surface area, a diminishing of population density. There is a virtual disappearance of Nymphaea alba zones in the Lake of Hallwil. From these results, the range of phosphorus threshold limit concentration which guarantees maintenance of submerged vegetation in a lake is around 200 microg/L. Consequently, the water quality objectives for this development in Swiss lakes can be established. (Brunone-PTT)
W91-12712

RECENT RE-OLIGOTROPHICATION IN MONDSEE (AUSTRIA) AS INDICATED BY

SEDIMENT DIATOM AND CHEMICAL STRATIGRAPHY.
Institut fuer Limnologie, Mondsee (Austria).
R. Schmidt.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 963-967, March 1991. 4 fig, 18 ref.

Descriptors: *Austria, *Diatoms, *Lake restoration, *Lake sediments, *Limnology, *Mondsee, *Oligotrophic lakes, *Phosphorus removal, *Species composition, *Water pollution control, Nutrients, Population density, Sediment chemistry, Sedimentation, Trophic status.

Seven years after the installation of the sewage treatment plant in Mondsee, Austria, the re-oligotrophication of Mondsee (with a theoretical renewal time of 1.7 years) is reflected by changes in sediment diatom assemblage structure and in the color, texture, and accumulation rates of the sediment. During the stage of decreasing nutrient loading, the diatom population structure seems to have been sensitive and unstable. Peak total phosphorus concentrations occurring in the surface layers of the sediment do not reflect the trophic state indicated by the water chemistry and diatoms. A marked lowering of the phosphorus values, which lay now within the general trend of decline, sediment compaction and less diatom concentration were observed in the former surface sediments of a second core taken four years after at the same sampling site. (Brunone-PTT)
W91-12716

ZOOPLANKTON CHANGES IN MONDSEE.
Institut fuer Limnologie, Mondsee (Austria).
For primary bibliographic entry see Field 2H.
W91-12718

REGULATORY MECHANISMS AND BEHAVIOUR OF COPPER IN AN INDUSTRIALLY-POLLUTED ACIDIC LAKE IN NORTHERN ITALY.
Istituto di Ricerca sulle Acque, Brugherio (Italy).
For primary bibliographic entry see Field 5B.
W91-12731

BREAKDOWN RATES OF ALDER (ALNUS GLUTINOSA) LEAVES IN AN ACID LAKE (LAKE ORTA, NORTH ITALY).
Istituto Italiano di Idrobiologia, Pallanza (Italy).
C. Bonacina, G. Bonomi, S. Gazzera, and G. Salmoiraghi.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1041-1043, March 1991. 2 fig, 2 tab, 21 ref.

Descriptors: *Acid lakes, *Alder trees, *Decomposition, *Detritus, *Industrial wastes, *Italy, *Lake Orta, *Lake restoration, *Liming, *Path of pollutants, *Water pollution effects, Alkalinity, Ammonium, Aquatic organisms, Feeding rates, Hydrogen ion concentration, Nitrates, Species composition, Thermal stratification, Toxicity, Water temperature.

Lake Orta underwent heavy industrial pollution during the last fifty years. The main in-lake effects were a progressive accumulation of ammonium and nitrates, destruction of the naturally low alkaline reserve and lowering of pH to values around 4, and destruction of the biological community remarkably convergent with that of lakes acidified by acid rain. Liming operations began in 1989, and the effect of liming was evaluated on the rate of leaf processing and macrobenthos colonization. Decaying alder (Alnus glutinosa) leaves were collected and dried, and leaf packs were prepared. Experiments were conducted in limed and non-limed areas. A high proportion of leaf weight loss was represented by leaching, which accounts for 27 to 29% of initial weight. A clear decrease of decomposition rate was noted in all sites, most probably due to the interaction between pH, solubilization of toxic metals and their effect on microzoobenthos and macrozoobenthos. Slow processing rates were essentially explained by a difference in shredder number and biomass; few shredders were found associated with the leaves processed in the acidified lake. Few organisms appeared to colonize the leaf packs. Temperature, pH and ammonia values between the two sites were similar, with differences between the stations due to the period of thermal stratification. (Brunone-PTT)
W91-12732

MASS BUDGET AS A TOOL FOR PREDICTING THE RESPONSE TO LIMING OF THE ACIDIFIED, AMMONIUM POLLUTED LAKE ORTA.
Istituto Italiano di Idrobiologia, Pallanza (Italy).
R. Mosello, A. Calderoni, and R. de Bernardi.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1044-1048, March 1991. 2 fig, 3 tab, 11 ref.

Descriptors: *Acid lakes, *Acid rain, *Acidification, *Ammonium, *Industrial wastes, *Italy, *Lake Orta, *Lake restoration, *Liming, *Model studies, *Nitrates, *Water pollution control, *Water pollution effects, Alkalinity, Drainage basins, Hydrogen ion concentration, Mathematical models, Water chemistry, Weathering.

Lake Orta is a heavily polluted lake in northern Italy, with elevated ammonium and nitrate concentrations. In 1981, the rayon factory partially responsible for the pollution constructed a treatment plant for ammonium to reduce the pollution load from 2000-2400 tons N/year to 30 tons N/year. A mass budget study was started to quantify the major ion inputs from the drainage basin, the in-lake transformation of ammonium and the outputs. The major ion budget shows that watershed weathering is the most important source of inorganic ions, with the exception of calcium, sulfate, and ammonium, a substantial amount of which comes from the rayon factory. The atmospheric deposition in the Lake Orta area is acidic, with mean annual pH between 4.4 and 4.5, and contributes significantly to the hydrogen and ammonium loads on the lake surface, while the weathering of the drainage basin results in a slightly positive contribution of alkalinity to the lake. Comparison of the masses entering and leaving the lake shows considerable imbalance in ammonium and nitrate, whose output is higher than the respective input because of the huge store of these substances in the lake. The substantial decrease of ammonium input since 1981 has been producing a gradual recovery of the water quality of the lake. To forecast the time necessary for lake water to reach original alkalinity, a simple input-output model was used, which takes into account the acidity/alkalinity variation in time. The model indicated that, in the absence of any treatment, the alkalinity = 0 condition would be reached in about five years, while alkalinity will be between 0.1 and 0.2 eq/cu m, a value more suitable for biological activity, in ten to fifteen years. Since 1989, Lake Orta has been limed with approximately 4700 tons of calcium carbonate. The first results have been positive, for lake chemistry. (Brunone-PTT)
W91-12733

CHAOHU LAKE EUTROPHICATION AND NUTRIENT LOAD REDUCTION.
Academia Sinica, Beijing (China). Research Center for Eco-Environmental Sciences.
For primary bibliographic entry see Field 5C.
W91-12741

USE OF ALUMINIUM SULPHATE TO CONTROL ALGAL BLOOMS AND CHIRONOMIDS IN JACKADDER LAKE, WESTERN AUSTRALIA.
Murdoch Univ. (Western Australia). School of Biological and Environmental Sciences.
M. A. Lund, and E. T. Chester.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1129-1133, March 1991. 1 fig, 15 ref.

Descriptors: *Algal blooms, *Algal control, *Alum, *Aluminum sulfate, *Australia, *Fertilizers, *Insect control, *Jackadder Lake, *Lake restoration, *Midges, *Water pollution control, Chlorophyta, Conductivity, Cyanophyta, Dissolved oxygen, Hydrogen ion concentration, Nutrient concentrations, Pollution control, Vegetation, Water depth, Water sampling, Water temperature.

Jackadder Lake, in western Australia, is a shallow lake with approximately 95% of the fringing vegetation has been cleared for lawns. Inputs of fertilizers entering of lake via surface runoff have elevated phosphorus concentrations to eutrophic levels (>10 microg P/L). Blooms of Microcystis aeruginosa or green algae are common throughout the year, producing ideal conditions for the growth of the nuisance chironomid, Polypedilum nubifer. An attempt to reduce nutrient levels to control chironomid abundance through food limitation rather than continued reliance on pesticides was made in Jackadder Lake. The lake was treated with alum to obtain a pH of 6. Samples were collected in both treated and control areas, over a seven month period. At each site, water depth, temperature and oxygen profiles, plankton and water samples were taken. No changes were recorded in water depth and conductivity that could be attributed to the treatment, although conductivity increased as a result of evapoconcentration occurring in the warmer summer months. Dissolved oxygen concentrations and pH were not significantly different between the treated and the control areas. Alkalinity decreased by 42% immediately after treatment, but by day 13 had returned to pretreatment levels. The greatest effects on nutrient levels were observed 13 days after treatment. Total phosphorus was significantly different between areas and following treatment. Zooplankton species richness was not significantly affected by the treatment either before or after treatment or between control and treatment. On day 13, numbers of rotifers and cyclopoids decreased. The alum treatment appeared to have no long-term detrimental effects on macroinvertebrates or zooplankton. At present, the reduction in total phosphorus has not been sufficient to eliminate the algal blooms. Thus, the effect of the treatment on nuisance chironomid levels will be minor. Monitoring of the lake is continuing to assess long-term effects of alum treatment. (Brunone-PTT)
W91-12750

ASSESSING THE USE OF AQUATIC PLANTS FOR WASTEWATER TREATMENT IN A HIGH ELEVATION TROPICAL LAKE.
Universidad Nacional del Altiplano, Puno (Peru). Inst. de Aquas Alto Andinas.
For primary bibliographic entry see Field 5D.
W91-12761

SPATIAL VARIABILITY IN 14C ESTIMATES OF PHYTOPLANKTON PRODUCTIVITY IN KENTUCKY LAKE, AN IMPOUNDMENT OF THE TENNESSEE RIVER, U.S.A.
Murray State Univ., KY. Hancock Biological Station.
For primary bibliographic entry see Field 2H.
W91-12784

BIOREGULATION MEASURES IN DRINKING WATER STORAGE RESERVOIRS IN THE ANTWERP REGION, BELGIUM.
Ghent Rijksuniversiteit (Belgium).
J. de Maeseneer, J. Meheus, J. Ceulemans, J. Janssens, and F. Schmidt.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1309-1312, March 1991. 3 tab, 8 ref.

Descriptors: *Algal blooms, *Bioremediation, *Drinking water, *Lake morphology, *Lake restoration, *Reservoirs, *Storage reservoirs, *Water pollution control, *Water pollution treatment, Aquatic plants, Belgium, Chlorophyll a, Debris, Fisheries, Mussels, Phytoplankton, Population density, Water quality monitoring, Waterfleas, Zooplankton.

Bioregulation measures were taken in drinking water storage reservoirs in the Antwerp Region of Belgium. The absence of bottom structure seemed to be the main reason for predictable and massive blooming of problem algae. Stones provided habitat for some cladocerans, and the numbers and composition of the colonizing biocenosis was greatly enhanced by the presence of submerged plants. In winter, submerged plants slowly reduce to small survival structures which can easily be overlooked. Yet, even in the winter, they are of crucial importance: their debris provide food for zooplankton; they provide shelter for zooplankton; the regrowth starts early in the season; they compete with phytoplankton for nutrients; they provide a minimal survival density for zooplankters; they fix the detritus layer and prevent its disturbance; and some release substances into the water which inhibit some algal development. Fish stock evaluation by means of seining nets showed the ratio of coarse fish to predatory fish was bad. To alleviate this problem, basins were seined for coarse fish in the early spring, and young pike were introduced to the basins. Introduction of large mussels provides for removal of more algae from the basins. At Broechem, a consistent lowering of both the average and the maximum chlorophyll a loading was observed after bioregulatory measures were initiated. (Brunone-PTT)
W91-12786

ROLE OF NUTRIENT CYCLING AND HERBIVORY IN REGULATING PERIPHYTON COMMUNITIES IN LABORATORY STREAMS.
Oak Ridge National Lab., TN. Environmental Sciences Div.
P. J. Mulholland, A. D. Steinman, A. V. Palumbo, J. W. Elwood, and D. B. Kirschtel.
Ecology ECOLAR, Vol. 72, No. 3, p 966-982, June 1991. 9 fig, 3 tab, 83 ref. NSF Interagency Agreement No. 40-689-78, DOE Contract DE-AC05-84OR21400.

Descriptors: *Aquatic plants, *Cycling nutrients, *Herbivores, *Periphyton, *Streams, Algae, Biomass, Detritus, Litter, Nutrients, Phosphorus, Snails, Streamflow, Water quality.

Population, community, and ecosystem-level properties were studied in laboratory stream channels that had nutrient inputs reduced compared to channels where ambient nutrient levels were maintained. Nutrient inputs were reduced in four of eight channels by recirculating 90% of the flow, whereas the other four channels received once-through flow of spring water, and the interaction between herbivory and nutrients by varying the number of snails among streams with different nutrient input (circulation) regimes, were examined. Reduction in nutrient input via recirculation resulted in lower concentrations of nutrients in the water but did not result in significant differences in biomass, carbon fixation, or algal taxonomic composition. However, herbivory had large effects on these characteristics by reducing biomass and areal rates of carbon fixation and simplifying periphyton taxonomy and physiognomy. Lower rates of nutrient input significantly affected characteristics associated with nutrient cycling. Streams with reduced nutrient inputs had lower periphyton nutrient contents, higher ratios of total:net uptake of P from water, and higher rates of phosphatase activity than streams with ambient nutrient inputs. However, the effects of reduced nutrient input on cycling characteristics were reduced or eliminated by intense herbivory. These results indicate that nutrient cycling can increase in response to reductions in nutrient input once sufficient biomass or detritus accumulates to facilitate cycling, thereby allowing biomass accrual and carbon fixation rates to be maintained at levels achieved at higher nutrient inputs. In streams with low nutrient input, cycling can meet a large fraction of the nutrient demand of the periphyton. Because the experimental design involved a reduction from ambient nutrient levels rather than the usual enrichment techniques in aquatic ecosystems, observations were made about how biological structure and processes are influenced by external nutrient inputs at the low natural levels of most undisturbed streams. (Author's abstract)
W91-12806

DERIVING QUALITY CRITERIA FOR WATER AND SEDIMENT FROM THE RESULTS OF AQUATIC TOXICITY TESTS AND PRODUCT STANDARDS: APPLICATION OF THE EQUILIBRIUM PARTITIONING METHOD.
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
L. A. Van Der Kooij, D. Van De Meent, C. J. Van Leeuwen, and W. A. Bruggeman.
Water Research WATRAG, Vol. 25, No. 6, p 697-705, June 1991. 3 fig, 1 tab, 27 ref.

Descriptors: *Ecotoxicology, *Environmental monitoring, *Equilibrium partitioning, *Sediment contamination, *Water quality standards, Chemical properties, Health effects, Physical properties, Suspended particles, The Netherlands, Toxicity, Water policy.

An approach recently proposed in The Netherlands to use the equilibrium partitioning method to derive a coherent set of quality criteria for aquatic systems was examined. The quality criteria referred to dissolved concentrations, the concentrations in the suspended particles, the total (dissolved + particulate) concentrations and the concentrations in the sediment. The quality criteria have been derived for standard sediment, standard water and standard suspended matter. Emphasis was placed on the relation between effect data and physicochemical data. Two types of effect data were used: effects on aquatic toxicity (direct effects) and health related effects (product standards). Both types of data could be translated into quality criteria by means of equilibrium partitioning. The calculation of criteria in sediment and suspended matter required use of the solids-water partition coefficient. These quality criteria have been used to make water management policy for the next 10 years in The Netherlands. (Mertz-PTT)
W91-12855

NITROGEN-REMOVAL ALTERNATIVES FOR WASTEWATER TREATMENT PLANT EFFLUENT.
Parametrix, Inc., Sumner, WA.
For primary bibliographic entry see Field 5D.
W91-12875

MINING-RELATED NONPOINT-SOURCE POLLUTION.
Colorado School of Mines, Golden. Dept. of Environmental Sciences and Engineering Ecology.
R. R. H. Cohen, and J. Gorman.
Water Environment & Technology WAETEJ, Vol. 3, No. 6, p 55-59, June 1991. 5 fig.

Descriptors: *Groundwater pollution, *Mine drainage, *Mine wastes, *Nonpoint pollution sources, *Path of pollutants, *Radioactive wastes, *Toxic wastes, *Water pollution sources, Arsenic, Geochemistry, Hazard assessment, Heavy metals, Industrial wastes, Selenium, Soil properties, Thorium, Uranium, Water chemistry.

Some of the most damaging environmental impacts result from mining activities. Pollutants are transported from a mine site by mine drainage, runoff from tailings piles, fugitive dust and deposition, or percolation into the groundwater system. Metal wastes may be oxidized, reduced, dissolved, adsorbed, or precipitated, depending on the chemical conditions in the water. Radiotoxic wastes from the uranium mining and milling industry include uranium, thorium-230, radium-226, and radon-222 have led to a growing concern over the danger of radioactive contamination. Selenium toxicity is a problem frequently associated with uranium mining in the western U.S., where high selenium, arsenic, and molybdenum concentrations have been reported in uranium-rich areas. The chemical quality of surface waters in mining areas is the result of local and regional factors, including mineral composition, overburden, and underclay; mobility of selected chemical constituents in rocks, sediments, and mine soils; activity of chemotropic bacteria, mining, and reclamation methods; density of mining operations in a given watershed; seasonal fluctuations in regional stream discharges; and control technologies implemented to treat mine effluent. All must be considered in any assessment or plan to prevent, control, or clean up pollution from mines. (Agostine-PTT)
W91-12880

POTW IMPROVEMENTS RAISE WATER QUALITY.
Massachusetts Dept. of Environmental Protection, Westborough. Div. of Water Pollution Control.
For primary bibliographic entry see Field 5D.
W91-12883

EFFECT OF RESUSPENSION ON ALGAL PRODUCTION IN A SHALLOW LAKE.
Uppsala Univ. (Sweden). Dept. of Hydrology.
For primary bibliographic entry see Field 2H.
W91-12887

HYDROCARBONS IN THE INDIAN OCEAN WATER (IN RUSSIAN).
Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
For primary bibliographic entry see Field 2L.
W91-12896

NATURAL RESOURCE MANAGEMENT OF WATER AND LAND.
For primary bibliographic entry see Field 6A.
W91-12922

WATER AND LAND USE AND THE NORTH AMERICAN ARID LANDS.
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 6E.
W91-12923

AQUATIC WEEDS AND PUBLIC HEALTH.
Corps of Engineers, Washington, DC. Hydraulics and Hydrology Branch.
For primary bibliographic entry see Field 4A.
W91-12939

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

DYNAMIC IRRIGATION SCHEDULING WITH STOCHASTIC RAINFALL.
Kansas State Univ., Manhattan. Dept. of Industrial Engineering.
For primary bibliographic entry see Field 3F.
W91-11605

PUBLIC EDUCATION FOR PROTECTING COASTAL BARRIERS.
Ohio State Univ., Columbus. School of Natural Resources.
G. W. Mullins, and H. Neuhauser.
Bioscience BISNAS, Vol. 41, No. 5, p 326-330, May 1991. 9 ref.

Descriptors: *Barrier islands, *Biosphere reserves, *Coastal plains, *Coastal zone management, *Conservation, *Environmental policy, *Planning, *Social aspects, Atlantic coast, Ecosystems, Education, Public participation, Public policy.

The biosphere-reserve system, which encompasses some of the Atlantic coastal barriers, provides an opportunity for conservationists to research and demonstrate ecologically sound and culturally sustainable uses of natural environments. The Man and the Biosphere (MAB) Reserve Program is an opportunity to create local and regional programs that have international significance and recognition. Since public education and public participation support social cohesion and economic well-being within any community, the biosphere-reserve communities have a far greater managerial role and responsibility than do communities near most parks and preserves. Several strategies are important to the effective establishment and use of

biosphere-reserve programs and cooperatives under the aegis of MAB, with public education and participation primary components of these strategies. (1) Establish functional biosphere-reserve programs; biosphere reserves should be viewed in a biogeocultural context that includes all landscapes and people contiguous to the core area. The biogeocultural approach helps to identify where links exist or where links can be forged to build and maintain a network for gathering and sharing information and taking collective action to care for the reserve. (2) Identify issues; community participation requires that issues of biosphere reserves be readily identifiable and understandable. To aid in carrying out programs, each reserve should develop a list of relevant issues, and education programs and public forums should begin to include these issues. (3) Identify stakeholders, those people or groups who have a vested interest in the well-being of the designated site or biogeocultural area in which the site is located. (4) Building an environmental ethic; environmental ethics must become deep-rooted cultural phenomena to effect change. Thus, an initial step is to involve all biosphere-reserve community members so that they see themselves as stakeholders on a consensus-based, nonhierarchical system. (Sand-PTT)
W91-11645

MANAGEMENT OF COASTAL BARRIER BIOSPHERE RESERVES.
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. R. Clark.
Bioscience BISNAS, Vol. 41, No. 5, p 331-336, May 1991. 2 fig, 11 ref.

Descriptors: *Barrier islands, *Biosphere reserves, *Coastal plains, *Coastal zone management, *Conservation, *Environmental policy, *Planning, Atlantic coast, Economic aspects, Ecosystems, Public participation, Public policy, Social aspects.

The approach developed by UNESCO's Man and the Biosphere program to protect biologically and culturally important areas can be used to conserve the natural resources of Atlantic coastal barrier ecosystems. The emphasis of the biosphere-reserve program is on sustainable use of resources as well as on protection of biological and ecological diversity; only limited core areas are designated exclusively for nature protection. The reserves serve three functions: conservation, science, and development. The core is dedicated to nature protection and, ideally, no economic use would be permitted there. A more difficult management problem lies with the multiple-use buffer and transition zones, where people are present and many activities occur. A model for US reserves should consider economic activity and conservation equally. To succeed, a biosphere-reserve program must be acceptable to the major stakeholders. The net economic benefits must be predicted and gains and losses explained openly. The net social benefits and the benefits to species and ecosystems must also be examined. The program needs clear objectives and a framework for cooperation to achieve them, ideally through development of a cooperative biosphere-reserve management plan. Administrators should consider ways to coordinate implementation of their authority to achieve their program goals within the context of the biosphere-reserve zonation scheme of core, buffer, and transition areas, with full-scale public involvement in every planning step. (Sand-PTT)
W91-11646

PROGRESS AND PROBLEMS OF IRRIGATION INVESTMENT IN SOUTH AND SOUTHEAST ASIA.
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3F.
W91-11803

RIOFISH, A FISHERY MANAGEMENT PLANNING MODEL FOR NEW MEXICO RESERVOIRS.
New Mexico State Univ., Las Cruces. Dept. of Fishery and Wildlife Sciences.
For primary bibliographic entry see Field 6B.
W91-11874

USE OF THE RAINS MODEL IN ACID RAIN NEGOTIATIONS IN EUROPE.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 5G.
W91-11962

DIOXIN BIOACCUMULATION: KEY TO A SOUND RISK ASSESSMENT METHODOLOGY.
Rifkin and Associates, Inc., Columbia, MD.
For primary bibliographic entry see Field 5B.
W91-12037

EVALUATION OF POLICIES FOR OPERATION OF RESERVOIR SYSTEMS (EVALUATION DES REGLES D'EXPLOITATION DE SYSTEMES DE RESERVOIRS).
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W91-12082

RELIABILITY-BASED DISTRIBUTION SYSTEM MAINTENANCE.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-12204

INTEGER PROGRAMMING APPLICATION FOR PLANNING OF HYDROPOWER PRODUCTION.
Southern California Edison Co., El Monte.
For primary bibliographic entry see Field 4A.
W91-12205

RECURRENCE INTERVAL OF GEOPHYSICAL EVENTS.
California Univ., Santa Barbara. Dept. of Geography.
For primary bibliographic entry see Field 7C.
W91-12207

APPROXIMATING CATASTROPHIC RISK THROUGH STATISTICS OF EXTREMES.
Analytic Sciences Corp., Reading, MA. Strategic Systems Div.
J. Mitsiopoulos, Y. Y. Haimes, and D. Li.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1223-1230, June 1991. 5 tab, 14 ref. NSF Grant ECE-8703935.

Descriptors: *Probability distribution, *Risk assessment, *Risks, *Statistical analysis, *Statistics, Approximation method, Catastrophic risk, Frequency distribution, Mathematical studies.

The approximation of the extreme-event risk function (f4) of the partitioned multi-objective risk method (PMRM) was analyzed. The analytic expression of the approximation for f4 is derived through the use of the statistics of extremes for cases where the underlying distribution is of an extreme-value type I, II, or III, and it thus provides an effective theoretical tool for understanding the behavior of conditional expected values for a large class of distribution functions used in science and engineering. The results are confirmed for example problems of normal, Gumbel, Weibull, Pareto, lognormal, and uniform distributions. The advantage of the approach is that it makes clear the connection between the conditional extreme-event expectation (f4) and the statistics of extremes. This connecting link is the asymptotic dependence of f4 on the shape of the 'tail' of the underlying distribution. (MacKeen-PTT)
W91-12236

WATERMATEX '91.
Proceedings of the Second International Conference on Systems Analysis in Water Quality Management, held June 3-6, 1991, Durham, New Hampshire. Water Science and Technology WSTED4, Vol. 24, No. 6, 1991. 353p.

Descriptors: *Model studies, *Planning, *Systems analysis, *Water pollution control, *Water quality management, Computer programs, Control systems, Data acquisition, Data interpretation, Decision making, Expert systems, Operating policies, Water management.

Rapid advances have been made in computer technology and in systems analysis of environmental systems. The purpose of the 1991 Watermatex conference was to discuss these advances and to provide a critical assessment of current technology. The conference format was designed to provide a bridge between theory and practice, and to allow access to computer facilities for demonstrations of the principles discussed in the platform presentations. Systems analysis is a matter of the exchange and progression of ideas across traditional disciplinary boundaries. It is a subject whose very foundations are an antidote to the natural tendency of the educational process to increasing specialization of interest. It frequently requires the development and use of a mathematical model, though it is by no means synonymous with mathematical modeling. Systems analysis is definitely concerned with the more formal, systematic analysis of decision-making situations, but it is also a subject whose objective may simply be the acquisition of a scientific understanding of a problem or a system's behavior. It seeks to distil, from a variety of perhaps superficially quite different problems, principles of problem-solving of a more general, universal nature. Specifically in the area of water quality management, systems analysis is concerned with all aspects of the water cycle and those facilities affecting and affected by the quality of that water. Its concerns range across the needs of planning and the needs of operational management. (See W91-12569 thru W91-12609) (Korn-PTT)
W91-12568

APPLICATION OF SYSTEMS ANALYSIS IN WATER POLLUTION CONTROL: PERSPECTIVES FOR CENTRAL AND EASTERN EUROPE.
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
L. Somlyody.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 73-87, 1991. 5 fig, 23 ref.

Descriptors: *Eutrophication, *Legislation, *Management planning, *Policy making, *Systems analysis, *Water pollution control, *Water quality management, *Water resources management, Danube River, Education, Gabcikovo-Nagymaros Barrage System, Hungary, Lake Balaton, Oxygen budget, Technology transfer, Training.

Recent major political changes in Central and Eastern Europe have opened new avenues for environmental and water quality management. In the past there was very little need for the application of systems analysis or any policy-related science to environmental issues. Due to past economic development paths, a large number of environmental problems now exist in Central and Eastern Europe. One exception is the eutrophication management control program for Lake Balaton in Hungary which has consistently incorporated both short- and long-term objectives when managing phosphorus loads and chlorophyll-a concentrations in the lake. An example where systematic assessment is missing even today is the Gabcikovo-Nagymaros barrage complex on the Danube River, where this type of analysis would be required to manage: (1) the eutrophication of the upstream reservoir of the complex, and (2) the oxygen budget of one of the side arms of the Danube. Future applications of systems analysis will depend primarily on institutional changes and environmental legislation; the necessary skill and scientific knowledge exist, but experience in application is lacking. Environmental education needs to be modernized, and a specialized technology transfer is needed to change institutional structures, legislation, and the training of managers. The most important task under the existing economic pressure is the preparation of well

tailored, cost-effective water pollution control strategies for the countries in question. This requires, in itself, a systems analytical approach. (See also W91-12568) (Author's abstract)
W91-12578

DEVELOPMENT OF BEST OPTIMUM SOLUTIONS TO DRAINAGE PROBLEMS.
Dundee Coll. of Technology (Scotland). Dept. of Civil Engineering.
R. M. Ashley, and M. J. Goodison.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 89-99, 1991. 3 fig, 3 tab, 19 ref.

Descriptors: *Combined sewer overflows, *Drainage, *Management planning, *Systems analysis, *Urban hydrology, *Urban planning, *Wastewater facilities, *Wastewater management, Catchment areas, Combined sewers, Computer programs, Cost analysis, Model studies.

New computer-based approaches to the management of wastewater systems have been developed in response to increasingly stringent legislation. Technical models are now available for the simulation and quality performance of sewerage systems, treatment works, and receiving waters. In order to formulate the best optimum solutions to accord with the requirements of legislation and minimize costs, cost models now need to be combined with the technical models. This will give an integrated suite of software as the basis for a holistic appraisal of wastewater system performance. Studies have been performed for the United Kingdom in which detailed research studies in one catchment provided the basis for the formulation of a planned holistic approach to a second catchment using systems analysis techniques. Further advancement of this approach can best be achieved by utilizing established systems-analysis techniques used in other areas of water resources technology. In order to apply these techniques, problems still have to be overcome relating to the efficacy of quality models, the data requirements for model proving, the assignment of appropriate cost factors (particularly to assess the intangible benefits), and the difficulties of forecasting. Benefits derived from the more integrated analysis will, by the optimum utilization of the capacity of sewerage systems and assimilative capability of receiving watercourses, result in considerable construction cost savings and more efficient wastewater system operation. (See also W91-12568) (Korn-PTT)
W91-12579

WATER POLLUTION SIMULATION OVER A RIVER BASIN USING A COMPUTER GRAPHIC MODEL.
Academia Sinica, Beijing (China). Inst. of Systems Science.
For primary bibliographic entry see Field 5B.
W91-12580

HYDRODYNAMIC WATER QUALITY SIMULATION--AN APPROXIMATIVE SOLUTION.
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft.
For primary bibliographic entry see Field 5B.
W91-12587

ELEMENTS OF MANAGEMENT SYSTEMS IN COASTAL REGIONS.
International Inst. of Hydraulic and Environmental Engineering, Delft (Netherlands).
M. B. Abbott, O. K. Jensen, and I. R. Warren.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 187-192, 1991. 1 fig, 2 ref.

Descriptors: *Aquatic Environment Management System, *Aquatic environment, *Coastal waters, *Information systems, *Management planning, *Water pollution control, *Water quality, *Water quality management, Computer programs, Data storage and retrieval, Databases, Environmental impact, Expert systems, Legislation, Model studies, Monitoring, Numerical models.

Progress made in the numerical modeling of coastal regions now allows for an elaboration of more complete and realistic management systems for these regions. However, such systems must take cognisance not only of chemical and biological processes, but also of legislative and other social constraints. The feasibility of such a management system was investigated in the design of an Aquatic Environment Management System (AEMS). The first part of the management system is composed of all monitoring and data acquisition facilities. Platforms for the modeling systems will normally be the hydrodynamic stages providing surface elevations and current speeds over the entire model area. Dependent on the type of study, water quality and sediment transport modeling will naturally follow. In a combined analysis of the modeling results and field data, as registered in a central data base, the management system will regularly check the status (e.g., ecological state) in the aquatic area. Furthermore, it will regularly check the predictions given by the different computational modules against the actual field measurements. This checked modeling system will then be used to predict the effects of present operations and management practices and to monitor the environmental impacts of planned human intervention on the future state of the specific aquatic environment. As currently envisaged, AEMS will function as expert-advice-serving systems. Incomplete AEMS are now being implemented in Denmark as part of the environmental management of the North Sea-Baltic connection during the construction of the Great Belt road and rail link. (See also W91-12568) (Korn-PTT)
W91-12591

OPTIMIZATION OF THE OPERATION OF THE OXIDATION DITCH PROCESS INCORPORATING A DYNAMIC MODEL.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-12596

RISK MANAGEMENT FOR NITRATE-CONTAMINATED GROUNDWATER SUPPLIES.
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W91-12634

DOUBLE CONTAINMENT IN INDUSTRIAL WASTEWATER TREATMENT PLANTS.
IBM Corp., Austin, TX.
For primary bibliographic entry see Field 5D.
W91-12877

NATURAL RESOURCE MANAGEMENT OF WATER AND LAND.
Van Nostrand Reinhold, New York. 1990. 192p. Edited by Edward O. Gangstad.

Descriptors: *Aquatic weed control, *Management planning, *Natural resources, *Resources management, *Water resources management, Flood control, Herbicide residues, Navigation, Public health, Recreation, Remote sensing, Water law, Water resources development, Wildlife conservation.

The issues concerning the land and water resources of the United States are varied and complex, involving industrial and domestic water supplies, hydroelectric power, irrigation, pollution control, fish and wildlife enhancement, recreational use, flood control, and navigation. The management of natural water resources in various parts of the country is highlighted in this book, which includes detailed coverage of environmentally sensitive areas, such as arid lands and the American prairies; evaluations of current water law and natural resource management strategies; up-to-date information on the conservation of wildlife resources; and a description of the use of remote sensing in resource management. The pros and cons of different chemical and biological technologies used to manage natural resources are illustrated in descriptions of various programs which control the spread of alligatorweed, Eurasian water milfoil, and other aquatic plants. The dissipation of residues of the aquatic weed control herbicide 2,4-D in water, soil, and fish is also discussed. Case studies are presented covering a water-hyacinth control plan for a Florida river, the Corps of Engineers' aquatic-plant management program, a plan to manage lake vegetation, control of 'giant' blue-green algae, and the relationships between aquatic weeds and public health. (See W91-12923 thru W91-12939) (Doyle-PTT)
W91-12922

WATER AND LAND USE AND LAND CONSERVATION.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 24-38, 1 fig, 11 ref.

Descriptors: *Conservation, *Land use, *Omaha, *Urbanization, *Water resources management, *Water use, Environmental protection, Nebraska, Population dynamics, Recreation, Recreational facilities, Riparian land, River basin development, Urban planning.

Although leisure time activities are growing in importance in the United States, earlier state level studies found that the Omaha, Nebraska area lacks adequate recreational facilities. The region contains 34% of Nebraska's population but less than 2% of its recreational land. Large recreation land deficiencies exist in lake related recreation, public access to rivers (most of the river front property near the urban centers is privately owned) and preservation of unique ecological areas from urban encroachment. For the plains streams, improvement in water quality alone will not lead to the achievement of recreational land development, which is essentially precluded by the modifications brought about by intense human uses of the streams and associated lands and by the natural characteristics of the plains streams. Sites selected for recreational areas in the plains of the South Platte, and other areas of the midwest should be well drained, gently sloping, free from topographical or geological hindrances, and accessible and efficient sites should not encroach on the natural, scenic, esthetic, scientific, or historic values of the recreational area. The Corps of Engineers Urban Studies Program's goal is to help regions solve their water and related land resource problems. (See also W91-12922) (Doyle-PTT)
W91-12925

WATER AND LAND USE AND FISH AND WILDLIFE RESOURCES.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 39-56, 2 fig, 14 ref.

Descriptors: *Fish management, *Land use, *Resources development, *Resources management, *Water use, *Wildlife management, Environmental impact, Project planning, Resource management, Wildlife habitats.

One of the greatest problems with the protection of fish and wildlife resources has been the difficulty of quantifying their value. The traditional methodology based on man-day of use for such activities as fishing and hunting in an area after the completion of a resources-development project could often distort the picture of actual impact. The U.S. Fish and Wildlife Service has developed a methodology designed to overcome the problems associated with the man-day of use approach to planning by focusing instead on the habitat and its associated productivity. Habitat quality and quantity are integrated into a single index value called Habitat Units, based on measurable criteria in the habitat known to be important in providing life requisites of the fish and wildlife species of special interest. The procedures in the Service's Habitat Evaluation Procedures fill the need to offer a standardized, quantitative methodology for use in resource planning. Resource development must occur without the wholesale destruction of fish and wildlife, and planning agencies cannot contin-

ue to ignore environmental values. (See also W91-12922) (Doyle-PTT)
W91-12926

WATER AND LAND USE AND FUTURE PLANNING.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 72-87, 1 tab, 8 ref.

Descriptors: *Environmental impact statement, *Future planning, *Land use, *Public participation, *Public policy, *Water resources management, *Water use, Administrative agencies, Decision making, Legislation, Project planning, Resource management.

The National Environmental Policy Act of 1969 requires the preparation of a detailed Environmental Impact Statement (EIS) describing the environmental impact of a proposed action and providing a process for review by other governmental agencies and the general public as well. Historically, the environmental effects of projects were of minimal concern to either the Corps of Engineers, which is responsible for the planning, design, construction, and operation of water resources projects throughout the United States, or the general public. However in recent years an awareness of environmental impacts has developed and resulted in various legislative actions, numerous directives, publications and directives. People working within institutions make public policy decisions. Governmental institutions provide opportunities for citizens to have a say in decisions that will affect their lives. Important decisions are made during the planning process. The trend is to make planners out of politicians rather than politicians out of planners. Congress has given us the tools to make us custodians of a great national resource: a water resources organization that can get things done. (See also W91-12922) (Doyle-PTT)
W91-12928

CORPS OF ENGINEERS AQUATIC PLANT MANAGEMENT PROGRAM.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 146-151, 9 ref.

Descriptors: *Aquatic weed control, *Corps of Engineers, *Management planning, *Navigable waters, *Water resources management, Costs, Economic impact, Interagency cooperation, Research, Technology transfer.

The U.S. Army Corps of Engineers (USACE) Aquatic Plant Control Program for navigable waters is designed to deal primarily with weed infestations of major economic significance. To achieve this goal a management framework was developed. All USACE Aquatic Plant Control Program management decisions involve four basic elements: (1) technology transfer, (2) research, (3) control operations, and (4) planning. Once researchers have developed a potential control tool, a smooth transition from research to operational status is needed. This process is called technology transfer. Applied research is developed by the Office of the Chief of Engineers with the assistance of the Interagency Aquatic Plant Control Research Advisory Committee and the appropriate Division Engineer. The research is accomplished through contracts with federal, state and private research institutions. An Aquatic Plant Control Operations Support Center provides technical expertise and guidance to those requesting planning assistance. Planning is developed by reporting officers in accordance with their needs. Normally, the program is initiated by a reconnaissance report and accomplished by means of design memoranda which establish a continuing program and enable the Chief of Engineers to allot funds on a priority basis. (See also W91-12922) (Doyle-PTT)
W91-12936

DEVELOPING A PLAN TO MANAGE LAKE VEGETATION.
Wisconsin Geological and Natural History Survey, Madison.
S. A. Nichols, S. Engel, and T. McNabb.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 152-159, 12 ref.

Descriptors: *Aquatic weed control, *Lake management, *Management planning, *Water resources management, Cost-benefit analysis, Environmental impact, Herbicides, Mechanical control, Recreation, Wildlife habitats.

A successful plan to manage a lake's aquatic plants consists of four parts: (1) problem definition, (2) understanding of plant ecology, (3) consideration of available control techniques, and (4) monitoring of the results. The plant community should be surveyed to determine whether or not there is a significant problem and, if so, which species need to be controlled. A map of the lake's plant cover may be drawn, showing habitats valuable to fish and waterfowl, as well as boating, fishing, and swimming areas. Every chemical, mechanical, habitat manipulation, and biological technique has limitations, short and long term risks, and environmental consequences. There may be hidden costs for maintaining equipment, repeating treatment, and restoring habitat. Each method's benefits should be weighed against its cost and environmental impact. Herbicides can be applied rapidly, but treatment costs increase with water depth and lake dilution. Herbicides may also kill invertebrates vital as fish and waterfowl food. Mechanical treatments such as cutter barges and harvesters can be used in selective areas which they free for immediate use, but these methods may create turbidity and leave plant fragments to drift ashore. Lake-management planning should promote desirable species and improve habitat and should also be integrated with watershed management to control both internal and external nutrient loading. (See also W91-12922) (Doyle-PTT)
W91-12937

6B. Evaluation Process

IMPACT TARGETS VERSUS DISCHARGE STANDARDS IN AGRICULTURAL POLLUTION MANAGEMENT.
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W91-11614

RIOFISH, A FISHERY MANAGEMENT PLANNING MODEL FOR NEW MEXICO RESERVOIRS.
New Mexico State Univ., Las Cruces. Dept. of Fishery and Wildlife Sciences.
R. Cole, T. Ward, F. Ward, R. Deitner, and S. Bolton.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-159483. Price codes: A14 in paper copy, A02 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 253, December 1990. 288p, 30 fig, 41 tab, 58 ref. State Project No. 1423612.

Descriptors: *Fish management, *Fisheries, *Model studies, *New Mexico, *Planning, *RIOFISH planning model, *Recreation, *Simulation, Canadian River, Decision making, Pecos River, Rio Grande, San Juan River, Sport fishing.

This report describes a sportfishery planning model, RIOFISH, developed for use in large New Mexico reservoirs. RIOFISH is a comprehensive planning tool that simulates a fishery planning system including procedural input, the socioecosystem, and outputs pertaining to fishing opportunity and angler benefit. RIOFISH organizes information into simulations of reservoir inventories and can be used to forecast resource and angler response to management strategies applied in different possible planning environments. The model also may be used to facilitate decisions based on anticipated angler benefit and agency management costs. RIOFISH can be used to evaluate which parts of the planning system have the most impact on model outputs and require the greatest resource attention. RIOFISH simulates hydrologic, biologic, and socioeconomic interactions in 16 large reservoir fisheries of the Rio Grande and the Canadian, Pecos and San Juan rivers. The model user can modify water levels; reservoir exchange rate; concentrations of nutrients, suspended matter, and organic matter; temperature; solar radiation; fish stocking rate and regulations; fish introduction, removals and mortality effects; and road and boat ramp access. Outputs include simulation of river and reservoir hydrology, water quality, organic loads, fish production and catchable sportfish, catch rates, recreational days and angler benefits. RIOFISH is run reiteratively, with each subsequent model scenario contrasted with an initial reference run. (Cole-NM St Univ.)
W91-11874

COMPARATIVE PERFORMANCE OF INSTITUTIONAL ARRANGEMENTS FOR GROUNDWATER RESOURCES.
Indiana Univ. at Bloomington. Workshop on Political Theory and Policy Analysis.
For primary bibliographic entry see Field 6E.
W91-11877

WATER RESOURCE USES AND RECREATIONAL ACTIVITIES IN RURAL NIGERIA.
Ilorin Univ. (Nigeria). Dept. of Agricultural Extension and Rural Development.
For primary bibliographic entry see Field 6D.
W91-12114

STREAM HABITAT ASSESSMENT PROGRAMS IN STATES OF THE AFS NORTH CENTRAL DIVISION.
Meyer (W.E.), State College, PA.
L. L. Osborne, B. Dickson, M. Ebbers, R. Ford, and J. Lyons.
Fisheries (Bethesda) FISHDN, Vol. 16, No. 3, p 28-35, May/June 1991. 2 fig, 4 tab, 16 ref.

Descriptors: *Aquatic habitats, *Performance evaluation, *Stream fisheries, *Surveys, Physical properties, Seasonal variation, Streams, Water resources management.

Streams and rivers in the North Central Division (NCD) of the American Fisheries Society (AFS) range in size from intermittent headwater streams to the Mississippi River, and represent both warm-, and cold water systems. In recognition of the diverse objectives and needs of fisheries management agencies, the NCD's Rivers and Streams Committee (RSC) was established in 1988 (1) to facilitate communication of stream-related information among NCD members; and (2) to identify stream and river research and management problems. At the initial RSC meeting, the need for accurate and rapid habitat assessment methodologies was identified. Habitat assessment programs used by each NCD state were therefore surveyed to identify: (1) the principal agency(ies) responsible for habitat assessment; (2) their goals; (3) the physical habitat variables measured and the protocols used; and (4) concerns and needs that may require a substantive, organized research effort. The most disturbing findings from this survey were the inability of programs to account for temporal variation in physical habitat (discharge, depth, cover), and the scarcity of programs that integrate physical habitat with water quality information. Most programs generally restricted sampling to warm, low-flow months; further, this de-emphasis of temporal variability (diel, seasonal, and year-to-year variation) is not a simple oversight, but rather a response to limited time, manpower, and financial resources (personal communication with state representatives). Even with additional resources, the successful identification of a limiting parameter will likely remain problematic if that parameter is temporally out of phase with the sampling time. Although this survey was restricted to physical habitat parameters, water quality data are also important in assessing stream habitat. (Lantz-PTT)

W91-12174

DEVELOPMENT OF A CONTROL STRATEGY TO REDUCE COMBINED SEWERAGE OVERFLOWS: THE CASE OF BREMEN-LEFT OF THE WESER.
Hanover Univ. (Germany, F.R.). Inst. fuer Verkehrswirtschaft.
For primary bibliographic entry see Field 5G.
W91-12593

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PHYSICAL AND ECONOMIC BENEFITS OF SUBSURFACE DRAINAGE BY SOIL TYPE IN EASTERN ONTARIO.
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 3F.
W91-11604

ECONOMIC FEASIBILITY OF AGRICULTURAL MANAGEMENT PRACTICES FOR REDUCING SEDIMENTATION IN A WATER SUPPLY LAKE.
Missouri Univ.-Columbia. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4D.
W91-11612

COMPARATIVE ECONOMIC ANALYSIS: ANAEROBIC DIGESTER CASE STUDY.
North Carolina Dept. of Economic and Community Development, Raleigh. Energy Div.
For primary bibliographic entry see Field 5D.
W91-11780

METHODOLOGY FOR LEAST-COST DESIGN OF INVULNERABLE WATER DISTRIBUTION NETWORKS.
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W91-11783

COST OF EDIBLE FISH--EFFECTS ON THE SWEDISH AND FINNISH FOREST INDUSTRIES FROM THE IMPOSITION OF EFFLUENT CHARGES ON CHLORINE RESIDUALS IN SWEDEN.
Sveriges Lantbruksuniversitet, Umea. Dept. of Forest Economics.
For primary bibliographic entry see Field 5G.
W91-11973

SELECTING OPTIMUM DISCHARGE RATE FOR WATER WELL.
Memphis State Univ., TN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W91-12567

SOME WAYS TO IMPROVE THE NATIONAL ECONOMIC EFFICIENCY OF HYDROPOWER ENGINEERING.
S. E. Brzhezyanskii.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 531-534, 1991. 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 36-38, August 1990.

Descriptors: *Cost sharing, *Economic aspects, *Hydroelectric plants, *Multipurpose reservoirs, Irrigation water, Recreation, Reservoir design, Soviet Union.

During the long-term operation of hydroelectric stations with multi-purpose reservoirs, the water resources and uses can change significantly. For instance, the Novosibirsk hydro development and reservoir were initially constructed primarily for power and water transport purposes, yet through time, the reservoir is also used more for irrigation and recreation purposes. During its construction, the hydropower industry financed most of its cost while now, the irrigation and recreation sectors benefit from its existence. Consequently, costs should be distributed among the many sectors that utilize the reservoirs; first during the planning stage and later during its operation. Economical balance between the electric power and water management systems needs to be achieved so that during water shortage periods the hydropower industry is compensated for limiting water flow for power while the water users receive the water they need. Furthermore, the gross potential, i.e. the maximum energy production of the river, should be evaluated prior to siting an hydroelectric station to increase the economic potential of the hydro development. Through evaluation of the economic potential of a site and consideration of nonenergy water users, funds for the renewal of hydropower resources will be available. (Collins-PTT)
W91-12620

6D. Water Demand

RESIDENTIAL WATER USE: A CASE STUDY OF THE MAJOR CITIES OF THE WESTERN REGION OF SAUDI ARABIA.
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
O. S. Abu Rizaiza.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 667-671, May 1991. 4 tab, 9 ref.

Descriptors: *Domestic water, *Prices, *Saudi Arabia, *Water use, Case studies, Economic aspects, Model studies, Pipelines, Social aspects, Temperature.

Socioeconomic and climatological data of the major cities of the western region of Saudi Arabia (Jeddah, Mecca, Medina and Taif) were used to develop several models to estimate residential water usage for different kinds of houses. The models correlate water usage with temperature, income, family size, price of water, and availability of a garden within the house. The study shows that residential water use in houses supplied by a public pipe network are 1.4-2 times greater than residential water use in houses supplied by tankers. It also shows that the price elasticities are very similar to those estimated for the United States. Income elasticities, on the other hand, are lower than those typically found in more industrialized countries. Houses in the expensive tanker supply areas would be expected to exhibit an inelastic usage, since the residents are forced to keep water use to essentials. Conversely, those with network distribution would be expected to use water more freely, so that price charges would be a more important factor. Income elasticities, on the other hand, are lower than those typically found in the more network-served areas, at a surprisingly low 0.09-0.07. This is most likely due to the predominance of apartment dwellings plus cultural differences. (Doria-PTT)
W91-11720

FUTURE WATER ISSUES: CONFRONTATION OR COMPROMISE.
Parsons, Behle, and Latimer, Salt Lake City, UT.
For primary bibliographic entry see Field 6E.
W91-11749

INTENSIVE PRODUCTION OF OREOCHROMIS MOSSAMBICUS (PETERS) WITH SPECIAL REFERENCE TO THE RELATIONSHIP BETWEEN WATER EXCHANGE RATE AND GROWTH RATE.
Zululand Univ., Empangeni (South Africa).
For primary bibliographic entry see Field 8I.
W91-11769

EVALUATION OF WATER RESOURCES OF ORANGE AND EASTERN JEFFERSON COUNTIES, TEXAS.
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 2F.
W91-11834

EVALUATION OF WATER RESOURCES IN PART OF NORTH-CENTRAL TEXAS.
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 2F.
W91-11836

EVALUATION OF WATER RESOURCES IN PART OF CENTRAL TEXAS.
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 2F.
W91-11838

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN A PART OF CURRY COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 2F.
W91-11850

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN CENTRAL LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 2F.
W91-11851

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN NORTHERN LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 2F.
W91-11852

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN PORTALES VALLEY, ROOSEVELT COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 2F.
W91-11853

WATER USE IN THE ST. JONES RIVER BASIN, KENT COUNTY, DELAWARE, 1983-86.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 4B.
W91-11863

SUMMARY AND ANALYSIS OF WATER-USE DATA COLLECTION IN EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
N. T. Baker.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4177, 1991. 25p, 10 fig, 4 tab, 10 ref.

Descriptors: *Arkansas, *Data collections, *Water use, Groundwater use, Surface water use.

The collection of water-use data has been an integral part of water resources investigations in eastern Arkansas for many years. Although water-use data reports are published periodically, there has been little documentation of how water-use data were collected in the past, how data currently are collected, the types of data collected, or the quality of the data collected. This report provides such documentation and evaluates the reliability of current water use data for making management decisions. Although total water-use amounts reported to the Arkansas Soil and Water Conservation Commission and U.S. Geological Survey aggregated estimates for irrigation are in good agreement for 1988, significant differences occur for some counties where site-specific data are sparse. Site-specific data are needed to understand current water demands and evaluate trends in water use, to establish a dynamic 'baseline' for allocation pur-

poses, and to improve aggregated water-use estimates over current estimates based on statistical sampling or regional calculations. (USGS)
W91-11937

PUBLIC-SUPPLY WATER USE IN FLORIDA, 1987.
Geological Survey, Tallahassee, FL. Water Resources Div.
R. L. Marella.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-596, 1990. 81p, 14 fig, 71 tab, 24 ref.

Descriptors: *Florida, *Municipal water, *Water use, Water distribution, Water supply.

Public-supply water use in Florida for 1987 was 1,811.1 million gal/day, and served nearly 10.4 million residents. Groundwater supplied 90% (1,635 million gal/day) of the public supply water in 1987, and served 9.34 million residents, and surface water supplied 176 million gallons/day and served 1.06 million residents. Public-supply per capita use for Florida in 1987 was 174 gallons/day. Public supply water use in Florida increased nearly 1,281 million gallons/day or 242% between 1960 and 1987. The South Florida Water Management District had the largest percent (48.0) of public-supply use followed by Southwest Florida Water Management District (22.3%) and the St. Johns River Water Management District (22.1%), Northwest Florida Water Management District (6.9%), and the Suwannee River Water Management District (0.7%). Groundwater was the primary source of public supply water for all five water management districts in 1987. Dade County had used the largest amount of water for public-supply use in the State for 1987, using 352.1 million gallons/day to serve 1.73 million residents. The use of groundwater for public supply occurred in all but two counties during 1987 as only Manatee, and Okeechobee counties relied solely on surface water for public supply use. Collier County had the highest public supply per capita water use in 1987 (299 gallons/day), compared to the statewide average per capita of 174 gallons/day. (USGS)
W91-11946

SUMMARY OF REPORTED WATER USE FOR ARKANSAS COUNTIES, 1989.
Geological Survey, Little Rock, AR. Water Resources Div.
N. T. Baker, and C. A. Manning.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-203, 1991. 19p, 4 fig, 3 tab.

Descriptors: *Arkansas, *Groundwater use, *Water use, Data collections, Surface water use, Withdrawal.

This report provides an aggregation and summarization of the water withdrawal information reported to the Arkansas Soil and Water Conservation Commission for 1989. Reported water withdrawals for 1989 were 4,120 million gal/day for groundwater and 2,286 million gal/day for surface water. The largest withdrawals occur in the agricultural region of the Mississippi River Alluvial Plain. This report also provides water application statistics for livestock and irrigated crops. (USGS)
W91-11953

WATER USE AS A COMMONS DILEMMA: THE EFFECTS OF EDUCATION THAT FOCUSES ON LONG-TERM CONSEQUENCES AND INDIVIDUAL ACTION.
Pomona Coll., Claremont, CA.
For primary bibliographic entry see Field 3D.
W91-12113

WATER RESOURCE USES AND RECREATIONAL ACTIVITIES IN RURAL NIGERIA.
Ilorin Univ. (Nigeria). Dept. of Agricultural Extension and Rural Development.
A. Adekoya.
Environmental Education & Information EEDIEF, Vol. 10, No. 1, p 37-44, January/March 1991. 8 ref.

Descriptors: *Nigeria, *Recreation, *Rural areas, *Social aspects, *Water use, Cost-benefit analysis, Economic aspects, Irrigation, Tourism, Water demand, Water resources development.

Surveys were taken of residents of rural areas in Nigeria to develop strategies to facilitate support for water resource development for recreational activities and tourism purposes. To investigate the part that self-interest plays in the acceptance of water resource development projects, the residents were asked a series of questions related to water body development (expansion of a dam and a lake) for recreational purposes. The respondents were asked: (1) to estimate costs to the local or state governments and compare it with the possible benefits to residents; (2) about outdoor recreational activities for which a body of water may be used, such as fishing, swimming, or boating; (3) to perceive the costs and benefits to residents of alternative development purposes of the body of water such as irrigation, flood control, hydroelectric power generation, and municipal and industrial water supply; and (4) about the effect of such developments on the value of land around the projects and the income of people close to the sites. Results of the interviews were analyzed according to two occupational groups: those in agriculture-related occupations, including farming and food processing and those in financial institutions, teaching, civil service and related white collar jobs. Respondents in the agriculture-related occupations generally did not favor state funds being used to support water development projects for tourism and recreational purposes, but did support water development projects that would be used for irrigation, or perhaps commercial fishing or hydroelectric power generation. The white collar respondents generally did favor state funds being used to finance water development projects that would be used for tourism and recreational purposes. To satisfy both groups and maintain farmer support for projects, it is suggested that water from the proposed dam expansion be used for irrigation purposes when demand for it for recreational and tourism purposes is not very high. (Geiger-PTT)
W91-12114

WATER, DAMS AND HYDROPOWER IN THE COMING DECADES.
Harza Engineering Co., Chicago, IL.
J. A. Veltrop.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 6, p 37-41, 43-44, June 1991. 6 fig, 8 tab, 19 ref.

Descriptors: *Dams, *Future planning, *Hydroelectric power, *Water demand, *Water supply, Environmental effects, Planning, Public participation, Social aspects, Water shortage.

Total global water use doubled between 1940 and 1980 and is expected to double again by the year 2000. Continued construction of dams is needed to alleviate serious water shortages and to provide electrical energy worldwide. Water shortages are becoming more and more apparent in many parts of the world. Because of the uneven distribution of water resources in time and space, more capture and storage of flood runoff is necessary for subsequent distribution and for low river flow augmentation. Dams are the most effective means of achieving these purposes. Hydropower contributed 21% to total electric energy generation in the world in 1989. However, only 14.5% of hydro potential worldwide has been developed. Large, high-head hydro projects are more economical than small, low-head ones, and the benefits of multipurpose dams should be exploited. Small-scale hydro is especially suitable for providing electricity to isolated communities. The many constraints on the further development of dams and hydropower must be accommodated properly. Adverse environmental and social impacts must be mitigated to the fullest extent possible. Many opportunities exist for engineers to contribute to both water resource and hydroelectric development. To effect the future development of dams and hydro projects, it is recommended that the profession implement a program of actions to: (1) address society's concerns about adverse environmental and social impacts; (2) include involvement of all persons affected; and (3) emphasize cooperation rather than confrontation. (Rochester-PTT)
W91-12197

PREDICTING WATER CONSUMPTION FROM HOMEOWNERS' ATTITUDES.
G. J. Syme, C. Seligman, and J. F. Thomas.
Journal of Environmental Systems JEVSBH, Vol. 20, No. 2, p 157-168, 1990/1. 3 fig, 30 ref.

Descriptors: *Australia, *Domestic water, *Public opinion, *Surveys, *Water use, Costs, Data acquisition, Perth, Public participation, Recreation, Water supply.

Previous research has failed to find a significant correlation between attitudes and water consumption, possibly because the earlier studies measured attitudes during drought conditions and used self-report measures that were unreliable. The present research studied a sample of 333 households in Perth, Australia, measured the homeowners' attitudes during a drought-free period, and collected actual, household water consumption data for an entire year. The results showed that attitudes pertaining to the importance of the garden as a house investment and a source of recreation were significant predictors of water use, as were homeowners' attitudes toward the current cost of water. These results are consistent with other research that shows that specific attitudes are correlated with resource consumption. (Author's abstract)
W91-12287

COMPARABLE ESTIMATES OF THE RECREATIONAL VALUE OF RIVERS.
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
L. D. Sanders, R. G. Walsh, and J. R. McKean.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1387-1394, July 1991. 1 tab, 46 ref, append.

Descriptors: *Contingent valuation method, *Recreation, *Rivers, *Travel cost method, *Water use, Comparison studies, Data interpretation, Rocky Mountains, Surveys.

The contingent valuation method (CVM) and travel cost method (TCM) methods for estimating the various aspects of water demand recommended by federal guidelines, were applied to the problem of estimating recreation benefits in a case study of rivers in the Colorado Rocky Mountains. The primary purpose was to assess the validity of the behavioral intentions reported in CVM surveys compared to actual behavior-based TCM analysis. Alternative contingent valuation and travel cost procedures were applied to determine the sensitivity of the estimates to the choice of method. Specifically, a household survey was conducted of the general population of the state to report CVM values separately for a recent trip to a study site, and for annual recreation use as a portion of the total value of river protection. Apparently, a single CVM question on willingness to pay for a recent trip provides a reasonably consistent estimate. It was shown that results are not significantly different for the alternative CVM, which can provide reliable estimates from on-site visitor surveys and household surveys of the general population. The data also show that TCM values are within the range of values for the alternative CVM models, suggesting that CVM questions obtain results consistent with actual behavior as measured by the individual observation TCM with and without adjusting for the probability of participation at long-run values. (Lantz-PTT)
W91-12315

EVALUATION OF MUNICIPAL WATER SUPPLY OPERATING RULES USING STOCHASTIC DOMINANCE.
National Pingtung Inst. of Agriculture (Taiwan). Dept. of Agricultural Engineering.
M. D. Su, R. Narayanan, T. C. Hughes, and A. B.

Bishop.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1519-1527, July 1991. 7 fig, 3 tab, 23 ref.

Descriptors: *Economic aspects, *Municipal water, *Stochastic process, *Water supply, Costs, History, Model studies, Water demand, Water use.

A procedure for evaluating and selecting among alternative rules for operating a municipal water supply system is outlined, based on the assumption that monthly water demands and supplies are random. Total cost, however, is affected by both current month and future water allocation decisions with respect to the operation of facilities. A perfect foresight model using mixed integer programming was developed and applied to 36 years of historical demand and supply data. Using the solutions to this model, several simple operating rules were derived and applied to the historical data to simulate system operation, and cumulative distribution of net revenue for each rule. Based on first-degree and second-degree stochastic dominance criteria, the performance of alternative rules were evaluated. The procedure was repeated with a set of generated data sequences to check the consistency of the solutions. Average reduction of up to 11% in annual net revenues from those of a perfect foresight model were observed, for various operating rules. Using stochastically dominant rules, it was shown that annual revenues can be increased by 5% on the average from a commonly used rule based on unit cost. (Author's abstract)
W91-12327

ESTIMATING CHANGES IN RECREATIONAL FISHING PARTICIPATION FROM NATIONAL WATER QUALITY POLICIES.
Economic Research Service, Washington, DC.
M. O. Ribaudo, and S. L. Piper.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1757-1763, July 1991. 2 tab, 29 ref.

Descriptors: *Fishing, *Public policy, *Recreation, *Water pollution control, *Water quality, *Water resources management, *Water use, Decision making, Management planning, Mathematical models, Model studies, Recreational fishing, Statistical models.

The complete evaluation of the off-site effects of national policies or programs that affect levels of agricultural nonpoint source pollution requires linking extensive water quality changes to changes in recreational activity. A sequential decision model was specified to describe an individual's decision s about fishing, and a participation model for recreation fishing that includes a water quality index reflecting regional water quality was developed and estimated as a logit model with national level data. In addition, a visitation model for those who decide to fish, that also includes the water quality index, was derived using ordinary least squares. The water quality index was found to be significant in the participation model but not in the visitation model. Together, the two models provide a means of estimating how changes in water quality might influence the number of recreation days devoted to fishing. The model is used to estimate changes in fishing participation for the Conservation Reserve Program. (Author's abstract)
W91-12349

DETERMINATION OF THE AVAILABLE WATER RESOURCES OF USSR RIVERS.
For primary bibliographic entry see Field 4A.
W91-12621

WATER WITHDRAWALS IN THE ROANOKE-CHOWAN SUBREGION OF NORTH CAROLINA AND VIRGINIA, 1983.
Geological Survey, Raleigh, NC. Water Resources Div.
M. W. Treece.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4007, 1990. 1 map sheet, 11 ref.

Descriptors: *Chowan-Roanoke subregion, *North Carolina, *Pumpage, *Virginia, *Water demand, *Water supply, *Water use, Chowan basin, Industrial water, Irrigation water, Municipal water, Roanoke basin.

The Chowan-Roanoke Subregion of North Carolina and Virginia comprises an area of about 18,300 sq mi, of which 7,600 sq mi are in North Carolina and 10,700 sq mi are in Virginia. Precipitation in the region is relatively high, and therefore water supplies appear to be plentiful. However, projected increases in water withdrawals, proposed interbasin diversions, and limited storage could reduce the amount of water available to meet the water use demand in the region. This report summarizes water withdrawals for the relatively dry year 1983 by type of use and county for the Subregion. Total surface and groundwater withdrawals in the Subregion were about 3,660 million gal/day; 95% was withdrawn in North Carolina where large amounts of water were withdrawn at four thermoelectric powerplants. Self-supplied industries accounted for the second largest withdrawal of water (206 million gal/day), which was 55% of the water withdrawals excluding power generation. Also, industries accounted for about 57% of the total groundwater withdrawals in the Subregion. (USGS)
W91-12657

WATER AND LAND USE AND LAND CONSERVATION.
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 6A.
W91-12925

WATER AND LAND USE AND FISH AND WILDLIFE RESOURCES.
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 6A.
W91-12926

WATER AND LAND USE AND REMOTE SENSING.
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 7B.
W91-12927

WATER AND LAND USE AND FUTURE PLANNING.
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 6A.
W91-12928

6E. Water Law and Institutions

GWALTNEY OF SMITHFIELD V. CHESAPEAKE BAY FOUNDATION: SUBJECT MATTER JURISDICTION AND CITIZEN SUITS.
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
P. Key.
Environmental Law EVLWA8, Vol. 19, No. 1, p 93-117, 1989.

Descriptors: *Clean Water Act, *Law enforcement, *Public participation, *Water law, Legal aspects, Legislation, NPDES, Public policy, Water policy.

Under the citizen suit provision of the Clean Water Act (CWA), if a citizen could not base suits on past violations or good faith allegations of ongoing or intermittent violations, pollutant dischargers could continue to use a large loophole by violating the Act until citizens gave notice of intent to sue as required by the Act. By then ceasing to violate the Act, unlawful dischargers could avoid prosecution for violations that the Environmental Protection Agency did not pursue and citizens could not pursue. This result would have undermined the deterrent effects suits by citizens in their 'private attorneys general' role created by Congress under the CWA and other environmental statutes with nearly identical citizen suit provisions. The Supreme Court's holding in Gwaltney essentially closed this loophole and established a relatively easy test for subject matter jurisdiction for citizen suits under most environmental statutes; however, the Court also precluded citizens from basing actions upon wholly past violations. Section II of this paper gives a brief history of citizen enforcement. Section III discusses the primary sections of the Act that pertain to citizen suites, the Act's legislative history, and the use of section 505 suits to enforce National Pollutant Discharge Elimination System (NPDES) permits. Section IV discusses the First and Fourth Circuits' interpretations of section 505. Section VI examines the Supreme Court's determination of the meaning of 'alleged to be in violation.' Section VII examines the ramifications of Gwaltney. Finally, Section VIII concludes that the Court created a relatively easy subject matter jurisdiction test for citizens bringing suit under section 505 or other similarly worded environmental statutes, and that few future citizen-plaintiffs will fail this test. (See also W91-11681) (Feder-PTT)
W91-11680

GWALTNEY OF SMITHFIELD V. CHESAPEAKE BAY FOUNDATION: A NEW FORM OF SUBJECT MATTER JURISDICTION UNDER SECTION 505 OF THE CLEAN WATER ACT.
P. Scatena.
Environmental Law EVLWA8, Vol. 19, No. 1, p 119-139, 1989.

Descriptors: *Clean Water Act, *Jurisdiction, *Law enforcement, *Public participation, *Water law, Legal aspects, Legislation, Public policy, Water policy.

The Supreme Court recently settled one question that has created much conflict among the United States Courts of Appeals. It decided, in Gwaltney of Smithfield vs. Chesapeake Bay Foundation, that citizens bringing suit under the enforcement provisions of the Clean Water Act (Act) must allege a continuous or intermittent violation of the Act, rather than a wholly past violation. The Court may have opened the door to a new conflict among the circuits in the area of federal jurisdiction. The majority opinion cited no cases or legislative history in support of its decision on this point, relying solely on the language of the Act. The federal courts are vested with limited jurisdiction; establishing subject matter jurisdiction is a constitutional and statutory requirement. The Supreme Court's decision could raise important questions regarding Congress's intent to create a new form of subject matter jurisdiction and congressional power to do so. (See also W91-11680) (Author's abstract)
W91-11681

FUTURE WATER ISSUES: CONFRONTATION OR COMPROMISE.
Parsons, Behle, and Latimer, Salt Lake City, UT.
S. M. Matheson.
Journal of Soil and Water Conservation JSWCA3, Vol. 46, No. 2, p 96-99, March/April 1991.

Descriptors: *Water conservation, *Water demand, *Water law, *Water management, Economic aspects, Legislation, Public policy, Regulations.

The past 15 years have brought dramatic changes in federal and state water policies, particularly when contrasted with historical and traditional means of dealing with water problems in the western United States. Western water law has developed through the accretion of custom and experience to reflect the realities of life in an arid region. Water rights are acquired only by beneficial use and can be lost by nonuse. However, many changes have occurred throughout the country and especially in the West. Therefore, water policies of the 19th century no longer meet the needs of the 20th century and certainly will not be appropriate in the 21st century. Options being considered by implementing agencies include: (1) improving the efficiency of federal water project use and making the saved water available for instream

purposes; (2) amending the authorizing legislation for specific projects to provide minimum flows for downstream use; and (3) including provisions in amending legislation to restrict project diversions during certain periods of critically low streamflows. It is likely that three related trends or factors will play an important role in water policy over the next few decades: physical limitations of water; public demands; and economic influence. (White-Reimer-PTT)
W91-11749

MARINE AND ESTUARINE PROTECTED AREAS IN TASMANIA, AUSTRALIA: THE COMPLEXITIES OF POLICY DEVELOPMENT.
Tasmania Univ., Hobart (Australia). Environmental Studies.
L. K. Kriwoken, and M. Haward.
Ocean & Shoreline Management OSMAE6, Vol. 15, No. 2, p 143-163, 1991. 2 fig, 2 tab, 47 ref.

Descriptors: *Environmental protection, *Estuaries, *Marine environment, *Public policy, *Tasmania, Australia, Case studies, Government agencies, Institutions, Interagency cooperation, Resources management, Social aspects.

Although international support for marine and estuarine protected areas (MEPAs) has been evident since the 1960s, national and sub-national governments have often been slow to establish MEPAs. Attempts to establish MEPAs in the Australian State of Tasmania were used as a case study of the complexities of policy development. The case study highlights the influence of legislative, institutional, and political factors in the development of MEPAs. The Tasmanian case study indicates that reducing interagency conflict over policy parameters is a major factor in successful policy implementation. Policy priorities must be clearly defined, and agencies responsible for a MEPA policy should be given adequate support, to promote the policy. The development of policy should involve consultation with all potential users of an area (through the form of advisory committees) and incorporate community education and public awareness prior to the announcement of draft policies. Public comment should be sought prior to implementation and adequate consideration should be given to procedures for evaluating this comment. In federations where responsibility over MEPAs is divided between national and State governments, coordination between the national and subnational marine protected area policy is appropriate. The Tasmanian case illustrates the current limitations in Australian intergovernmental coordination over MEPAs. Recommendations of the interjurisdictional council, CONCOM, and its working groups, on the marine protected area, are not binding on either the Commonwealth or the States. While all Commonwealth and State conservation Ministers have agreed unanimously on these objectives there is no formal mechanism for the implementation of the IUCN/CONCOM recommendations. CONCOM has no power to force any tier of government to instigate either legislative or institutional reform with respect to marine protected areas. The Tasmanian case study also illustrates the problems in developing MEPAs based solely on ecological grounds. The collapse of proposals for marine protected areas in the early 1980s was due to a failure to appreciate the significance of other policy parameters. Proponents for MEPAs must, in addition to issues of marine ecology, address socio-economic issues concerning the proposal to ensure successful implementation. (Lantz-PTT)
W91-11799

COMPARATIVE PERFORMANCE OF INSTITUTIONAL ARRANGEMENTS FOR GROUNDWATER RESOURCES.
Indiana Univ. at Bloomington. Workshop on Political Theory and Policy Analysis.
E. Ostrom.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-159459. Price codes: A04 in paper copy, A01 in microfiches. Final Technical Report, December 1990. 58p, 308 ref. USGS Contract No. 14-08-0001-G1476.

Descriptors: *Administrative agenices, *California, *Groundwater basins, *Groundwater management, *Institutional constrainst, *Property rights, *Resource allocation, *Water costs, Los Angeles River, Mojave River Basin, River basins, San Gabriel River, Santa Ana River Basin, Water allocation, Watershed management.

This study examined these questions: (1) Does the allocation of groundwater production rights in Southern California enhance the effectiveness of the management system in reducing exposure to risk and increasing the efficiency of resource use. (2) Do less centralized groundwater management systems perform as well as, better than, or less than more centralized management systems on criteria of compliance, effectiveness in reducing exposure, efficiency, equity, and adaptability. (3) Is there an optimal institutional 'formula' for groundwater management. A comparative case-study of the institutional development of eight groundwater basins located on the South Coastal Plain of California was performed including: four basins in the San Gabriel River watershed (Raymond, West Coast, Centra, and Main San Gabriel Basins); one within the Los Angeles River watershed (San Fernando Valley Basin); two in the Santa Ana River watershed (Orange County and Chino Basins); and the Mojave River Basin encompassing the Mojave River watershed. The cases demonstrate that complex, water resource systems can be designed and managed by users at relatively low costs and high levels of effectiveness, equity and adaptability without creating a sole 'manager.' These institutions are, however, delicate and require considerable craftsmanship. No single institutional formula can be prescribed that will match the diverse geologic, hydrologic and historical patterns in an area. (USGS)
W91-11877

LIMITS OF PRIVATE RIGHTS IN PUBLIC WATERS.
J. L. Sax.
Environmental Law EVLWA8, Vol. 19, No. 3, p 473-483, 1989.

Descriptors: *Instream flow, *Instream water use, *Private water rights, *Property rights, *Public waters, *Resource allocation, *Water law, *Water pollution control, *Water rights, Agricultural water, Agricultural watersheds, Privatization, Public rights, Public trust doctrine, Recreation, Water quality, Water use efficiency, Water value.

Increasing demand for instream flows to protect downstream water quality can be met without violating vested property rights in water. Private property claims in water have always been subordinate to the right of the public to maintain its waters 'undiminished except by such drafts upon them as the guardian of the public welfare may permit...' The rights of water users have always changed to meet new public demands, whether for mill dams during the Industrial Revolution, for navigability to float logs during the timber era, or for reduced discharges under modern pollution laws. Holders of appropriative rights in the West will now similarly have to adapt to new conceptions of the public trust in public waters. Western water users have benefitted from a long period of subsidy in the form of public projects to supply them with new supplies to meet each new demand. The result has been a systematic deferral of the responsibility to accommodate beneficial use requirements. The new era is one of reallocation. The direction is changing from agriculture to urban uses and in-stream flows for water quality, recreation and ecosystem protection. The winners of this shift will be efficient urban areas and efficient farmers, in-stream values, and the federal taxpayer who has too long borne the burden of misplaced subsidization. (Feder-PTT)
W91-11954

WATER POLLUTION AND THE PUBLIC TRUST DOCTRINE.
R. W. Johnson.
Environmental Law EVLWA8, Vol. 19, No. 3, p 485-513, 1989.

Descriptors: *Nonpoint pollution sources, *Prior appropriation, *Public trust doctrine, *Water law, *Water policy, *Water pollution control, *Water quality, *Water rights, Common law, Farm wastes, Fisheries, Fishing, Navigation, Nitrates, Nitrogen, Pesticides, Police power, Property rights, State jurisdiction, Water resources management, Water scarcity.

The prior appropriation system has served well in the Western United States for 125 years, providing a legal regime that permits and encourages enormous economic growth of agriculture, industry and municipalities. This system, however, both in its inception and current application, fails to address or protect public interests in fisheries, recreation, environmental quality, and clean water. As a result, serious nonpoint water pollution problems are occurring throughout the West. Such pollution can be regulated either by the courts or the legislatures under the public trust doctrine, which antedates the prior appropriation system, and which protects fisheries and water quality. No one--including irrigators, industries or cities with appropriative rights--has a vested, constitutionally protected property right to degrade the quality of public waters. Some states are adopting police power regulations to control nonpoint pollution. Others are approaching the problem through the prior appropriation system itself, taking the position that beneficial use means use that does not harm the public through pollution. The public trust doctrine is not a panacea that will instantly solve all the conflicts that now surround the prior appropriation system. It should be considered, however, as a basis for setting standards as best practicable technology or best management practice. (Feder-PTT)
W91-11955

PUBLIC PROPERTY AND THE DEMOCRATIZATION OF WESTERN WATER LAW: A MODERN VIEW OF THE PUBLIC TRUST DOCTRINE.
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
M. C. Blumm.
Environmental Law EVLWA8, Vol. 19, No. 3, p 573-621, 1989. Oregon Sea Grant 81 AA-D-00086.

Descriptors: *Public access, *Public property, *Public trust doctrine, *Water law, *Water rights, Administrative decisions, Constitutional law, Easements, Public participation, Public policy, Remedies, State jurisdiction, Water quality control, Water resources management.

The public trust doctrine is best understood by the remedies it prescribes. Recent cases illustrate at least four different types of public trust remedies: (1) a public easement guaranteeing access to trust resources; (2) a restrictive servitude insulating public regulation of private activities against constitutional 'takings' claims; (3) a rule of statutory and constitutional construction disfavoring terminations of the trust; and (4) a requirement of reasoned administrative decision making. Although these remedies vary widely depending upon the jurisdiction and the context of the dispute, they all possess a unifying theme of promoting public access, either to the trust resources themselves or to decision makers with authority to allocate trust property. This public access theme makes the doctrine a democratizing force by preventing monopolization of trust resources and promoting natural resource decision making that involves and is accountable to the public. The public trust doctrine is a coherent body of law that supplies a necessary complement to prior appropriation principles, is not inconsistent with fifth amendment 'takings' jurisprudence, and has sufficient grounding in various state constitutions and statutes to continue to infuse public concerns into Western water law in the years ahead. (Feder-PTT)
W91-11956

PUBLIC TRUST AND IN-STREAM USES.
J. S. Stevens.
Environmental Law EVLWA8, Vol. 19, No. 3, p 605-621, 1989.

Descriptors: *American River, *Instream water use, *Legal aspects, *Mono Lake, *Public trust doctrine, *Water law, *Water rights, California, Diversion, Environmental protection, Judicial decisions.

As a common-law doctrine, the public trust can prevent the continued destruction of public waters. The doctrine as it applies to nonnavigable waters is reviewed, focusing on the California cases involving Mono Lake and the Lower American River. The California Supreme Court's decision in National Audubon Society v. Superior Court (Mono Lake) logically applied the public trust doctrine to diversions from the tributaries of a navigable lake. The Mono Lake ruling was further implemented and interpreted in Environmental Defense Fund v. East Bay Municipal Utility District, which attempted to prevent the utility from diverting water from the headwaters of the American River, to the detriment of downstream vegetation, wildlife, and recreational uses. Public trust considerations were intertwined with the appropriative water rights system long before the 1983 Mono Lake decision, and the doctrine will continue to impact future water decisions in California. (Shidler-PTT)
W91-11957

PUBLIC TRUST DOCTRINE IN IDAHO.
S. W. Reed.
Environmental Law EVLWA8, Vol. 19, No. 3, p 655-674, 1989.

Descriptors: *Diversion, *Idaho, *Instream flow, *Irrigation practices, *Legal aspects, *Public trust doctrine, *Water law, *Water rights, Beneficial use, Legislation, Public property, State jurisdiction.

Idaho has been dominated economically and politically by irrigation interests since before its admission into the Union in 1890. Nevertheless, the Idaho Supreme Court has embraced the public trust doctrine with the result that every applicant for future diversions of water has the burden of proving that the diversion would be in the public interest. In three cases decided between 1983 and 1986, the Idaho Supreme Court articulated, embraced and implanted the public trust doctrine upon Idaho in such strong language that the court made Idaho a leader in recognition of the identified concept: (1) In Kootenai, the Idaho court explicitly expanded the scope of the public trust to include inland waterways far beyond the traditional tidelands. (2) In Shokal, the court ruled that the applicant for the water right carries the burden of proof to establish that the project is in the public interest; the court looked to the statutes to find support for the imposition of public trust on water applications. (3) The Malad Canyon court held that an instream flow was a beneficial use of water and that a right could be perfected without physical diversion. (Feder-PTT)
W91-11958

PUBLIC TRUST DOCTRINE IN MONTANA: CONFLICT AT THE HEADWATERS.
Montana Environmental Quality Council, Helena.
D. B. Schmidt.
Environmental Law EVLWA8, Vol. 19, No. 3, p 675-682, 1989.

Descriptors: *Competing use, *Montana, *Public policy, *Public trust doctrine, *Resource management, *Water allocation, *Water law, *Water rights, Agriculture, Beneficial use, Irrigation, Legislation, Political aspects, Private water rights, Public participation, Public property, State jurisdiction, Water conservation.

Although large quantities of high quality water originate in Montana and leave its borders, the distribution of those waters results in water scarcity in the arid plains that cover much of the state. Many water users believe that Montana should examine its public trust responsibilities toward water in a legislative forum rather than wait for the courts to decide them. Some irrigators believe that Montana has already fulfilled its public trust responsibilities through legislation providing for water reservations, in-stream beneficial uses, and public interest criteria in new water permits. The irrigators also believe that the public trust doctrine protects water used for agricultural purposes. Whether the public trust doctrine will continue to be articulated and further defined in Montana depends upon the political will and initiative of water users and public policy makers. Unless prospects to resolve competing public and private interests improve, the courts will once again be called upon to settle the issue--perhaps with unsettling long-term results. (Feder-PTT)
W91-11959

PUBLIC TRUST PROTECTION FOR WETLANDS.
M. K. McCurdy.
Environmental Law EVLWA8, Vol. 19, No. 3, p 683-722, 1989.

Descriptors: *Environmental protection, *Natural resource, *Resources management, *Public trust doctrine, *Water law, *Water policy, *Wetlands, California, Navigable waters, Public property, State jurisdiction, Water rights.

Demands on natural resources have grown and changed dramatically since the Roman origins of the public trust doctrine. Public perception of the importance of the environment has also changed. Its value to us increases as remaining pristine areas decrease. The public trust doctrine offers courts a common-law method for protecting changing public expectations in natural resources. Today the public trust doctrine is not limited to tidal waterways. Federal and state court decisions have long recognized the public importance of nontidal waterways, and have accordingly applied the public trust doctrine to navigable inland lakes and streams. Recent court decisions have acknowledged that the public trust protects more than the three traditional uses of navigable waters. The trust encompasses swimming, bathing, hunting, boating, scientific study and recreational uses of navigable waterways. It also protects the food and habitat that navigable waterways provide for fish and wildlife. The public trust doctrine should protect wetlands because many wetlands are navigable. Those that are not navigable deserve protection because their resource value is similar to navigable waterways. (Feder-PTT)
W91-11960

OIL POLLUTION ACT OF 1990.
For primary bibliographic entry see Field 5G.
W91-11976

BERSANI V. EPA: THE EPA'S AUTHORITY UNDER THE CLEAN WATER ACT TO VETO SECTION 404 WETLAND-FILLING PERMITS.
For primary bibliographic entry see Field 5G.
W91-11979

NONPOINT SOURCE POLLUTION, GROUNDWATER, AND THE 1987 WATER QUALITY ACT: SECTION 208 REVISITED.
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
For primary bibliographic entry see Field 5G.
W91-11980

PROTECTING OREGON'S FREE-FLOWING WATER.
C. C. Reynolds.
Environmental Law EVLWA8, Vol. 19, No. 4, p 841-877, 1989. 181 ref.

Descriptors: *Environmental law, *Environmental protection, *Federal jurisdiction, *Legal aspects, *Oregon, *Public waters, *State jurisdiction, *Wild rivers, Dams, Recreation, Regulations, Water law, Watercourses.

Twenty years after Congress enacted the Wild and Scenic Rivers Act and eighteen years after Oregon passed the Scenic Waterways Act in 1970 by statewide initiative, the protection of free-flowing rivers and streams remains a challenge in Oregon. The Scenic Waterways Act of 1970 created an administrative procedure for extending the system of rivers and streams meriting protection. It calls for the protection of waterways for their outstanding scenic, fish, wildlife, geological, botanical, historic, archaeologic, and outdoor recreation value of both present and future benefit to the public. This procedure resulted in only six waterway studies and reports being completed from 1970 to 1988. Because of this slow administrative process further action took place at the state level, and in 1988, Congress passed the Omnibus Oregon Wild and Scenic Rivers Act in 1988 which adds 1429 miles to those already protected. This initiative was vastly supported by Oregonians. While the Scenic Waterways Act has come into direct conflict with the Federal Power Act, which traditionally preempts state law, a recent decision in California and other cases support legitimate state interests. A strong state waterways act, such as Oregon's, opens the door to dual federal and state protection, the chief advantage of which is to eliminate the problem of federal preemption. (Collins-PTT)
W91-11981

WETLAND PROTECTION UNDER SECTION 404 OF THE CLEAN WATER ACT: AN ENFORCEMENT PARADOX.
T. Griswold.
San Diego Law Review SDLRDO, Vol. 27, No. 1, p 139-181, 1990.

Descriptors: *Clean Water Act, *Enforcement, *Environmental law, *Environmental protection, *Wetlands, Alternative planning, Jurisdiction, Legal aspects, Public participation, Public policy, Regulations, Standards.

Section 404 of the Clean Water Act of 1977 (Act) is designed to protect some of the most sensitive and functionally valuable resources in America: the nation's wetlands. In the short history of the Act, a paradox has emerged between the purported intention of the Act and its enforcement. The paradox is that strong legislation exists to protect wetlands, but it is administered by agencies that appear reluctant to enforce its provisions. Despite overwhelming public support for the protection of wetlands and a regulatory framework that should significantly limit wetlands destruction, wetlands continue to disappear. The section 404 program is burdened with contradictory administration, misinterpreted guidelines, and ambiguous court decisions. Understaffed agencies have allocated their resources to streamline the regulatory process and to protect against only the most egregious losses. Meanwhile, piecemeal losses of wetland habitat add up to a collective catastrophic loss. Recent changes in the Act indicate that section 404 administration is improving, however, action from Congress is needed if the 'no net loss' goal of wetland protection is to be realized. In the meantime, citizen groups can facilitate considerable improvement by pursuing new angles in citizen lawsuits. (Collins-PTT)
W91-11986

RCRA GIVES TSDFS NO ROOM FOR ERROR.
Little (Arthur D.), Inc., Cambridge, MA.
For primary bibliographic entry see Field 5G.
W91-11992

ROLE OF FDA IN ESTABLISHING TOLERABLE LEVELS FOR DIOXIN AND PCBS IN AQUATIC ORGANISMS.
Food and Drug Administration, Washington, DC. Center for Food Safety and Applied Nutrition.
For primary bibliographic entry see Field 5G.
W91-12036

NEW CLEAN AIR ACT.
For primary bibliographic entry see Field 5G.
W91-12076

DISCHARGE BORDER WARS.
For primary bibliographic entry see Field 5G.
W91-12078

USE OF WETLANDS FOR WATER QUALITY IMPROVEMENT UNDER THE USEPA REGION V CLEAN LAKES PROGRAM.
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
For primary bibliographic entry see Field 5G.
W91-12115

NEW WATER TRANSFER RESTRICTIONS: THE WEST RETURNS TO RIPARIANISM.
Chicago-Kent Coll. of Law, IL.
A. D. Tarlock.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 987-994, June 1991. 48 ref.

Descriptors: *Riparian rights, *Water allocation, *Water law, *Water management, *Water policy, *Water rights, *Water transfer, *Western United States, Water resources management, Water use, Water users.

Fundamental shifts in water allocation and management are occurring throughout the West. Changing public values have reversed the historic preference for supply augmentation through the construction of new storage systems and replaced it with one for the reallocation of existing supplies. The emerging reallocation era will be characterized by the better management of existing supplies to serve both traditional and new user communities. Reallocation can be accomplished in three ways: (1) the rededication of unallocated or unused blocks of stored water on federal and state reservoirs; (2) the voluntary transfer of existing water rights; and (3) the redefinition of existing rights by judicial decisions and legislation which trim consumptive entitlements. While a coherent water allocation principle is currently lacking, efforts to reduce the transaction costs of transfers and to impose a number of ad hoc state and federal restraints on water transfers are being made. These new laws can greatly increase the costs of transfers and make them politically unattractive. The expanded recognition of traditional and new third party rights could produce a new riparianism in the West. This would overturn the law of prior appropriation which has thrived because it was premised on the severance of the right to use water from its source and allowed water to be allocated to new demands. In contrast, the common law of riparian rights confines water rights to landowners in the watershed of a stream. From the beginning, the western courts rejected the watershed limitation, but many recent transfer restraints modify the law of prior appropriation and reintroduce the principle of watershed protection rule in the form of a premise that river systems should be managed on an ecosystem basis. Emerging new watershed rules could make all transfers presumptively suspect. (Author's abstract)
W91-12214

WATER AND LAND USE AND THE NORTH AMERICAN ARID LANDS.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 3-15, 1 fig, 6 ref.

Descriptors: *Arid lands, *Water law, *Water pollution control, *Water resources management, *Water rights, *Water use, Governmental interrelationships, Land use, Legislation, Return flow.

Although the western states have moved a long way toward developing and managing the water resources in the arid areas between the Pacific coastal mountain ranges and the Rocky Mountains, continued management in the future depends upon the basic water-quality law doctrines adopted in 17 of the western states. One rule used by every western state is the doctrine of prior appropriation. The riparian doctrine applied in many of the dual-doctrine states is being eliminated as demands for surface water increase. Some state laws fail to require a viable record system for water rights, to integrate water quantity and quality control, or to provide incentives for recapturing and properly using return flows. To systematically attack the water-management problem, particularly the return-flow quality problem, changes in state laws must include efforts to achieve uniformity between interstate and intrastate laws and administration. Criteria must be developed for efficiency in allocation and use, and these criteria must be applied to all use--private and public. Lawmakers should specifically incorporate the element of water quality in water rights, and shift to a term permit or periodic evaluation of effective water use. Traditionally intergovernmental conflicts have occurred between state and federal water policies, particularly through new applications of the Federal Reservation Doctrine, and increased use of groundwater is redefining traditional surface water rights. Also of concern is the complexity of litigations and judgments. An ad hoc approach to resolving key water problems through the courts insures that the property-right concept will continue to be a critical roadblock to curative solutions. (See also W91-12922) (Doyle-PTT)
W91-12923

6G. Ecologic Impact Of Water Development

ZOOPLANKTON AND SALINITY IN THE RUFIJI RIVER DELTA, TANZANIA.
Dar es Salaam Univ. (Tanzania). Dept. of Zoology and Marine Biology.
D. J. Tafe.
Hydrobiologia HYDRB8, Vol. 208, No. 1/2, p 123-130, December 1990. 3 fig, 1 tab, 16 ref.

Descriptors: *Baseline studies, *Dam effects, *Ecological effects, *Hydroelectric power, *Reservoirs, *Rufiji River, *Salinity, *Species diversity, *Tanzania, *Water resources development, *Zooplankton, Copepods, Deltas, Diurnal variation, Estuaries, Population density, River mouth, Rivers, Sampling, Water supply.

The upper region of the Rufiji River has been proposed as the site for a reservoir large enough to supply fresh water and hydroelectric power to the entire coast region of Tanzania. If the proposal, which is still in the planning stage, comes to pass the ecological balance of the river downstream will be markedly affected. Therefore any information gathered on the present flora and fauna in the area is valuable for future reference. A comparative analysis of the zooplankton from different salinities was carried out in the Rufiji River delta system, located on the mid-Tanzania coastline opposite Mafia Island (7 degrees 45 minutes S, 39 degrees, 20 minutes W). Zooplankton samples were collected by vertical, oblique and horizontal surface tows (250 microm mesh) at three sites, namely at the river mouth (salinity = 20 to 25 ppt), in the estuary (salinity = 12 to 14 ppt), and in the upper reaches of the river (salinity = 0 ppt). Samples taken in the river mouth and estuary were collected at two times of the day, which coincided approximately with midday and sunset. A comparison of zooplankton diversity and abundance at the three sites showed that a much richer, more diverse fauna existed at the mouth and in the estuary compared to the upper reaches. The zooplankton collected both at the mouth and in the estuary were very abundant at certain times of the day, although differences in faunal composition were found between the two sites. (Brunone-PTT)
W91-11631

INITIAL EFFECTS OF DEFORESTATION ON PHYSICAL CHARACTERISTICS OF A BOREAL RIVER.
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
For primary bibliographic entry see Field 4C.
W91-11639

HYDROLOGIC EFFECTS OF WELL-FIELD OPERATIONS IN A WETLAND, DADE COUNTY, FLORIDA.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11858

ENVIRONMENTAL POLLUTION RESEARCH IN SOUTH AMERICA.
Sao Paulo Univ. (Brazil).
For primary bibliographic entry see Field 5G.
W91-11961

ENVIRONMENTAL IMPACTS OF CHANNELIZATION ON THE RIVER MAIN, COUNTRY ANTRIM, NORTHERN IRELAND.
Ulster Univ., Coleraine (Northern Ireland). Dept. of Environmental Studies.
D. N. Wilcock, and C. I. Essery.
Journal of Environmental Management JEVMAW, Vol. 32, No. 2, p 127-143, March 1991. 12 fig, 2 tab, 23 ref.

Descriptors: *Channeling, *Environmental effects, *Flow rates, *Northern Ireland, *Water table decline, Channel flow, Ecological effects, Flood plains, Flow characteristics, Sediment load, Suspended sediments.

A channelization scheme undertaken as part of its long-term land drainage program by the Department of Agriculture for Northern Ireland has been monitored continuously for three pre-channelization and three post-channelization years. Channelization withdraws water from storage and marginally increases mean daily and low flow. Water-table drawdown takes place solely immediately adjacent to the river and in highly permeable gravels. The geographical extent of a direct drainage benefit is limited. Peak suspended sediment loads are greatly increased and river habitat loss in important nursery grounds is substantial as a result of meander shortening. Increased hydraulic efficiency in the new channel reduces instream and floodplain storage. Many of the effects identified are quantified for the first time and illustrate the need both for more pre-impact and post-impact studies as a means of placing environmental impacts in a quantifiable perspective, and for greater communication between physical and biological scientists. In particular, there is a need for the formulation of interdisciplinary research projects. (Author's abstract)
W91-11972

ENVIRONMENTAL FATE OF TOXIC WASTES, THE CERTAINTY OF HARM, TOXIC TORTS, AND TOXIC REGULATION.
For primary bibliographic entry see Field 5G.
W91-11978

RECOVERY STRATEGIES FOR PIPING PLOVERS IN MANAGED COASTAL LANDSCAPES.
Massachusetts Div. of Fisheries and Wildlife, Westborough. Natural Heritage and Endangered Species Program.
S. M. Melvin, C. R. Griffin, and L. H. MacIvor.
Coastal Management CZMJBF, Vol. 19, No. 1, p 21-34, January/March 1991. 2 tab, 45 ref.

Descriptors: *Coastal environment, *Coastal zone management, *Environmental protection, *Piping plover, *Water birds, Beaches, Coastal engineering, Land use, Recreation, Resource management.

Piping plovers that nest and winter along the US Atlantic coast are threatened by cumulative impacts of habitat loss and alteration, human disturbance, and predation. Coastal stabilization activities may degrade plover habitat by altering natural processes of dune and beach erosion and accretion. Dredging and beach nourishment projects may be beneficial or detrimental to plovers, depending on timing and location. Management strategies to reduce disturbance and mortality caused by beachgoers and off-road vehicles include fencing of nesting and brood-rearing areas, partial or complete beach closures to pedestrians or vehicles during the breeding season, restrictions on pets, and public education. Beaches where piping plovers nest are owned and managed by a variety of federal and state agencies, county and municipal governments, private conservation organizations, and individuals. Wildlife biologists must work with coastal managers to implement multiple-use management

strategies that include protection for piping plovers and their habitats. (Author's abstract)
W91-12024

THREATS TO BIOLOGICAL DIVERSITY IN MARINE AND ESTUARINE ECOSYSTEMS OF FLORIDA.
Florida Inst. of Tech., Melbourne. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W91-12026

TRICHOPTERA AND SUBSTRATE STABILITY IN THE OCHRE RIVER, MANITOBA.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. G. Cobb, and J. F. Flannagan.
Hydrobiologia HYDRB8, Vol. 206, No. 1, p 29-38, October 15, 1990. 5 fig, 4 tab, 19 ref.

Descriptors: *Caddisflies, *Channeling, *Ecological effects, *Environmental effects, *Land use, *Ochre River, *Stream improvement, Canada, Manitoba, Population dynamics, Sedimentation, Stream biota, Stream stabilization.

A total of 3999 Trichoptera adults, represented by 8 families, 17 genera and 33 species was collected in emergence traps in 1983 and 1984 from five stations on the Ochre River, Manitoba. Species composition for the two years was comparable, but as the result of a summer spate in 1984, abundance was only 40% of that in 1983. Species diversity by station was negatively correlated with substrate instability of the reach, whereas density per trap was negatively correlated with substrate instability and local factors such as sedimentation in some reaches following peak discharges. Analysis of historical peak discharge records indicate that relatively infrequent mid-summer spates had a detrimental effect on the subsequent emergence of Trichoptera fauna. The combination of spates and unstable stream bed substrate resulting from land use practices, such as stream channeling in the drainage basin, have resulted in an impoverished caddisfly fauna in the Ochre River in comparison with other rivers in Manitoba. (Author's abstract)
W91-12123

GULF: PAST, PRESENT AND POSSIBLE FUTURE STATES.
Newcastle upon Tyne Univ. (England). Centre for Tropical Coastal Management Studies.
A. R. G. Price, and C. R. C. Sheppard.
Marine Pollution Bulletin MPNBAZ, Vol. 22, No. 5, p 222-227, May 1991. 18 ref.

Descriptors: *Environmental effects, *Marine environment, *Oil pollution, *Oil spills, *Persian Gulf, Kuwait, Microorganisms, Organic carbon, Phenols, Political aspects.

The Persian Gulf represents a complex dynamic system influenced by natural processes and a wide range of human activities and socio-political events, both related and unrelated to the present conflict (1991 invasion of Kuwait). Short-term and long-term future states of the region therefore cannot be accurately predicted, either environmentally or socially. However, some of the potential marine environmental consequences of the conflict are: oil pollution impacting the Gulf biota and the desalination plants along the coast; toxic substance releases from industries and powerplants located close to the Gulf (toxics such as phenols, benzenes, chlorine, and hydrochloric acid); air pollution impacts on the regional environment; and, microbiological pollutants from the destruction of sewage treatment facilities. Concern arises because of the vulnerability of the Gulf ecosystem to both past, present, and probably also future impacts on its vast array of interconnected ecosystems. From an ecological perspective, the best case scenario is one in which the current oil spillage and other potentially hazardous substances, largely remain in open water, and are kept away from sensitive coastal areas. The ending of the Gulf hostilities of course helps reduce environmental damage and facilitates natural recovery processes which could be fairly rapid except in areas that have been very heavily oiled. (Lantz-PTT)
W91-12401

SUMMER OXYGEN DEPLETION IN A DIKED NEW ENGLAND ESTUARY.
Cape Cod National Seashore, South Wellfleet, MA.
For primary bibliographic entry see Field 2L.
W91-12496

MODELING EFFECTS OF TIDAL BARRIER CLOSURE OF VENICE LAGOON.
California Univ., Davis. Dept. of Civil Engineering.
G. T. Orlob, A. E. Bale, H. Rajbhandari, and M. Malagoli.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 149-155, 1991. 4 fig, 2 ref.

Descriptors: *Environmental effects, *Eutrophication, *Hydrodynamics, *Italy, *Mathematical models, *Model studies, *Tidal barriers, *Venice Lagoon, *Water pollution control, *Water quality, *Water resources management, Hydraulic structures, Nonpoint pollution sources, Nutrients, Primary productivity, Simulation analysis.

As a result of land subsidence and sea level rise in the vicinity of the City of Venice, Italy there has been an increased incidence of flooding in Venice with occasionally disastrous consequences. Among the solutions proposed to solve the flooding problem is a modular tidal barrier that is designed to close the three major entrances to the shallow lagoon in which Venice is situated. Because the lagoon is highly eutrophic and circulation is driven primarily by tides in the Adriatic Sea, there is concern that operation of the barriers with could exacerbate an already serious pollution problem. Before construction of the barrier can begin an environmental impact assessment must be performed for the lagoon. Preliminary investigation of the effects of the proposed barrier scheme using mathematical hydrodynamic and water quality models suggests that prolonged isolation of the lagoon from the sea, if this should become necessary for flood protection, may enhance primary production and induce unfavorable water quality conditions. Moreover, because the eutrophic state of the lagoon is already so far advanced, it is likely that restricting circulation for an extended period would push certain water quality conditions past limits acceptable for maintaining a healthly ecosystem. This investigation revealed that mathematical models, in addition to interactive graphics, can be useful tools in support of decision processes leading toward the best possible solutions for the Venice Lagoon. (See also W91-12568) (Korn-PTT)
W91-12586

SALINE LAKE MICROCOSMS (MICROECOSYSTEMS) AS A METHOD OF INVESTIGATING ECOSYSTEM ATTRIBUTES.
Adelaide Univ. (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-12751

MICROBIAL MICROCOSMS OF THE CHEMOCLINE OF A MEROMICTIC LAKE IN RELATION TO CHANGING LEVELS OF PAR.
Valencia Univ. (Spain). Facultat de Ciencias Biologicas.
M. R. Miracle, E. Vicente, R. L. Croome, and P. A. Tyler.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1139-1144, March 1991. 1 fig, 23 ref.

Descriptors: *Dam effects, *Ecological effects, *Hydroelectric powerplants, *Light penetration, *Limnology, *Meromictic lakes, *Population dynamics, *Saline-freshwater interfaces, Australia, Chemocline, Microorganisms, Photosynthesis, Solar radiation.

Three small meromictic lakes adjacent to the Gordon River in Southwest Tasmania depend on periodic incursions of estuarine water for maintenance of the meromictic state. Regulation of river flow for hydro-electric power production prevented such incursions of salt water in recent years and the chemoclines were progressively eroded and deepened. The lakes became dystrophic, with marked attenuation and spectral modification of downwelling PAR (photosynthetically-active radiation). During the course of declining meromixis the chemocline sank beyond the level of penetration of PAR. Recently, there have been new incursions of salt water. The meromictic condition has been restored or augmented and the chemocline now lies higher in the water column. Microbial responses to such waxing and waning of the meromictic manifestations were investigated in one of the lakes (Lake Fidler). By April 1986, the chemocline of Lake Fidler, as determined by the change from microaerobic to anoxic conditions and from positive to negative apparent redox potentials, lay between about 2.5 m and 3.6 m. During the gradual descent to these levels, the photosynthetic microbes Trachelomonas volvocina, Chlorochromatium aggregatum, and Scourfieldia caeca, gradually disappeared or almost disappeared. Between April 1986 and February 1987 saline inflows occurred. Both Scourfieldia and Chlorochromatium returned to the lake, but Trachelomonas has not. The ecosystem appears more complex than in previous years. As the chemocline depth continues to change, the microbial communities will also change. Microzooplankters also exhibit a degree of zonation in the water column, probably attributable to nutritional needs. (Brunone-PTT)
W91-12752

MACROINVERTEBRATE COMMUNITY STRUCTURE AND IMPACT ASSESSMENT OF DAMS AND IMPOUNDING RESERVOIRS IN THE CAVADO RIVER BASIN (NORTHERN PORTUGAL).
Porto Univ. (Portugal). Inst. de Zoology.
For primary bibliographic entry see Field 2H.
W91-12797

MORTALITY OF JUVENILE CLUPEIDS DURING PASSAGE THROUGH A TIDAL, LOW-HEAD HYDROELECTRIC TURBINE AT ANNAPOLIS ROYAL, NOVA SCOTIA.
Acadia Univ., Wolfville (Nova Scotia). Dept. of Biology.
For primary bibliographic entry see Field 8I.
W91-12827

(BIO)GEOCHEMICAL REACTIONS IN AQUIFER MATERIAL FROM A THERMAL ENERGY STORAGE SITE.
Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology.
For primary bibliographic entry see Field 2K.
W91-12858

WATER AND LAND AND HERBIVOROUS FISH.
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 4A.
W91-12929

BIOLOGICAL CONTROL OPERATIONS ON ALLIGATORWEED.
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 4A.
W91-12930

7. RESOURCES DATA

7A. Network Design

INTERCOMPARISON OF HYDROLOGICAL NETWORK-DESIGN TECHNOLOGIES.
Geological Survey, Tucson, AZ.
M. E. Moss, and G. D. Tasker.
Hydrological Sciences Journal HSJODN, Vol. 36, No. 3, p 209-221, June 1991. 4 fig, 4 tab, 12 ref.

Descriptors: *Network design, *Statistical analysis, *Statistical methods, *Stream gaging, *Stream-

flow, Comparison studies, Mean annual flow, NARI, NAUGLS, Performance evaluation, Stream gages.

Two network-design technologies were compared by random sub-sampling of actual streamflow data. The technologies, Network Analysis for Regional Information (NARI) and Network Analysis Using Generalized Least Squares (NAUGLS), have a common objective--to maximize regional information within a limited budget and time horizon. The data used for intercomparison are from a network of 146 stream gages in the central part of the United States. In general, the results indicate that the NAUGLS method conveys more information than the NARI method to the network designer interested in maximizing regional information about mean annual flows with a limited budget. (Author's abstract)
W91-11792

RAINFALL NETWORK DESIGN THROUGH COMPARATIVE KRIGING METHODS.
Birmingham Univ. (England). Dept. of Civil Engineering.
A. H. M. Kassim, and N. T. Kottegoda.
Hydrological Sciences Journal HSJODN, Vol. 36, No. 3, p 223-240, June 1991. 9 fig, 26 ref.

Descriptors: *Kriging, *Network design, *Rainfall, Forecasting, Mapping, Model studies, Rainfall distribution, Runoff forecasting, Storms, Streamflow forecasting.

The methods of simple and disjunctive kriging were applied and compared in the estimation of optimum locations of recording rain gages as part of a network for the determination of storm characteristics to be used in forecasting and design. Direct comparison of the two methods does not reveal any major differences. However, the method of disjunctive kriging performs better in the sense that the estimated variance is more consistent. Furthermore, because a nonlinear estimator is expected to provide a better representation of spatial variability, preference may be given to the method of disjunctive kriging. In this study, the network design attempted to concentrate on individual storm events. Storms travel in different directions and their magnitudes vary. The distribution of rainfall also changes from one storm to another. These changing phenomena make the kriging methods rather complex to consider in network design when the distribution of the error map differs significantly from one storm to another. To reduce this uncertainty, the analysis should take into account all recorded storms in the area and average the differences, by using a weighting procedure if necessary. (Lantz-PTT)
W91-11793

PILOT STUDY FOR DELINEATION OF AREAS CONTRIBUTING WATER TO WELLFIELDS AT JACKSON, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
R. E. Broshears, J. F. Connell, and N. C. Short.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4201, 1991. 32p, 11 fig, 8 tab, 18 ref.

Descriptors: *Geohydrology, *Groundwater movement, *Groundwater pollution, *Tennessee, *Wellhead protection, Groundwater management.

The U.S. Geological Survey, in cooperation with the Tennessee Department of Health and Environment, and the Jackson Utility Division, conducted a pilot study to determine needs for data and the applicability of methods of delineation of areas contributing water to municipal wellfields. Jackson Utility Division, in Jackson, Madison County, Tennessee, pumps about 9 million gallons of groundwater daily from an unconfined sand aquifer. Under natural hydraulic gradients, groundwater flows southward towards the South Wellfield at approximately 2 to 3 ft/day; natural flow toward the North Wellfield is from the east at 1 to 2 ft/day. Water quality generally is suitable for most uses. Concentrations of dissolved solids are low, and excessive iron is the only significant naturally occurring problem. However, trace concentrations of volatile organic compounds have been detected in water pumped from the South Wellfield; the highest concentration of a single compound has been 23 microg/L of tetrachloroethylene. Potential sources of contamination include a hazardous-waste site, wastewater-discharge sites, municipal and industrial landfills, and underground storage tanks. Calculations based on a uniform flow analytical model provided a preliminary delineation of zones contributing water to wellfields and groundwater time-of-travel contours. (USGS)
W91-11915

PREDICTION OF TRACER PLUME MIGRATION IN DISORDERED POROUS MEDIA BY THE METHOD OF CONDITIONAL PROBABILITIES.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-12243

TELEMETERING SYSTEM SCHTROUMPH AT EDF (LE SCHTROUMPH A EDF: SYSTEME DE COLLECTE HORAIRE POUR TRAITEMENT DE RESEAU SUR ORDINATEUR UTILISE POUR LA MODELISATION ET LA PREVISION DE L'HYDRAULICITE).
Electricite de France, Grenoble. Div. Technique.
J. Herigault.
Houille Blanche HOBLAB, Vol. 1991, No. 2, p 155-157, 1991. English summary.

Descriptors: *Network design, *Telemetry, *Water resources management, Data storage and retrieval, Hydroelectric powerplants, Telecommunications, Water use.

Systeme de Collecte Horaire pour Traitement de Reseau sur Ordinateur Utilise pour la Modelisation et la Prevision de l'Hydraulicite (SCHTROUMPH) is a telemetering system to acquire the data required for adequate water use and management. The system uses the telephone network to acquire this data to manage the EDF hydro powerplant system. (Author's abstract)
W91-12421

WHAT IS THE BEST TIME REFERENCE TO EXPRESS BIOLOGICAL RESULTS: THE CALENDAR YEAR OR THE ECOLOGICAL YEAR.
Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Inst. de Limonologie.
For primary bibliographic entry see Field 2H.
W91-12709

7B. Data Acquisition

CENTRIFUGAL FLOTATION AS AN AID TO SEPARATING INVERTEBRATES FROM DETRITUS IN BENTHIC SAMPLES.
Toronto Univ. (Ontario). Div. of Life Sciences.
G. L. Cromar, and D. D. Williams.
Hydrobiologia HYDRB8, Vol. 209, No. 1, p 67-70, February 1991. 1 tab, 8 ref.

Descriptors: *Analytical methods, *Biological samples, *Bottom sampling, *Centrifugation, *Detritus, *Flotation, *Invertebrates, *Sample preparation, *Sampling, *Separation techniques, Accuracy, Copepods, Midges, Mites.

Prerequisite to most quantitative studies of benthic communities, populations or species is separation of organisms from background detritus and inorganic debris. Efficiency of hand sorting versus centrifugally floating benthic samples of high detritus composition was compared. Centrifugal flotation removed a large proportion (up to 90%) of the detritus, significantly increased recovery of several taxa (e.g. copepods, mites and chironomids), and decreased overall sorting time. Centrifugal flotation was effective for both live and preserved samples and was three to ten times more efficient than hand sorting. Use of centrifugal flotation has resulted in an increase in picking rate and accuracy as well as increased yields of several taxa in detritus laden benthic samples. Combined with staining, this technique is recommended for use in general benthic studies. (Brunone-PTT)
W91-11641

DAILY EVAPORATION OVER A REGION FROM LOWER BOUNDARY LAYER PROFILES MEASURED WITH RADIOSONDES.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2D.
W91-11728

AUTOMATIC, REAL-TIME MONITORING OF SOIL MOISTURE IN A REMOTE FIELD AREA WITH TIME DOMAIN REFLECTOMETRY.
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2G.
W91-11739

LARGE-SCALE NATURAL GRADIENT TRACER TEST IN SAND AND GRAVEL, CAPE COD, MASSACHUSETTS: I. EXPERIMENTAL DESIGN AND OBSERVED TRACER MOVEMENT.
Geological Survey, Marlborough, MA.
For primary bibliographic entry see Field 2F.
W91-11743

LARGE-SCALE NATURAL GRADIENT TRACER TEST IN SAND AND GRAVEL, CAPE COD, MASSACHUSETTS. II. ANALYSIS OF SPATIAL MOMENTS FOR A NONREACTIVE TRACER.
Geological Survey, Marlborough, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11744

SAMPLING DESIGN FOR GROUNDWATER SOLUTE TRANSPORT: TESTS OF METHODS AND ANALYSIS OF CAPE COD TRACER TEST DATA.
Geological Survey, Reston, VA.
D. S. Knopman, C. I. Voss, and S. P. Garabedian.
Water Resources Research WRERAQ, Vol. 27, No. 5, p 925-949, May 1991. 19 fig, 6 tab, 22 ref.

Descriptors: *Cape Cod, *Experimental design, *Groundwater movement, *Massachusetts, *Network design, *Sampling, *Solute transport, *Tracers, Bromides, Cost analysis, Error analysis, Field studies, Groundwater transport, Parameter estimation, Regression analysis, Statistical analysis, Wells.

Tests of a one-dimensional sampling design methodology on measurements of bromide concentration collected during the natural gradient tracer test conducted by the U. S. Geological Survey on Cape Cod, Massachusetts, demonstrate its efficacy for field studies of solute transport in groundwater and the utility of one-dimensional analysis. The methodology was applied to design of sparse two-dimensional networks of fully screened wells typical of those often used in engineering practice. In one-dimensional analysis, designs consist of the downstream distances to rows of wells oriented perpendicular to the groundwater flow direction and the timing of sampling to be carried out on each row. The power of a sampling design is measured as its effectiveness in simultaneously meeting objectives of model discrimination, parameter estimation, and cost minimization. One-dimensional models of solute transport, differing in processes affecting the solute and assumptions about the structure of the flow field, were considered for description of tracer cloud migration. When fitting each model using nonlinear regression, additive and multiplicative error forms were allowed for the residuals which consist of both random and model errors. The one-dimensional single-layer model of a nonreactive solute with multiplicative error was judged to be the best of those tested. Results show the efficacy of the methodology in

designing sparse but powerful networks. (Author's abstract)
W91-11745

THREE-DIMENSIONAL FIELD STUDY OF SOLUTE TRANSPORT THROUGH UNSATURATED, LAYERED, POROUS MEDIA. I. METHODOLOGY, MASS RECOVERY, AND MEAN TRANSPORT.
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W91-11746

GAS CHROMATOGRAPHIC SEPARATION OF CARBON DIOXIDE AND NITROUS OXIDE FOR STABLE ISOTOPIC ANALYSIS OF CARBON DIOXIDE.
Geological Survey, Reston, VA.
K. Revesz, and T. B. Coplen.
Analytical Chemistry, Vol. 62, p 972-973, 1990. 2 fig, 1 tab, 7 ref.

Descriptors: *Carbon dioxide, *Gas chromatography, *Laboratory methods, *Nitrous oxide, *Pollutant identification, Chemical analysis, Measuring instruments, Performance evaluation, Water analysis.

Analysis of atmospheric and unsaturated-zone CO2 for oxygen and carbon isotopic content is important for numerous environmental studies. Typically, CO2 is separated from the atmospheric sample by trapping at -196 C. The vapor pressure versus temperature characteristics of N2O are very similar to those of CO2, and N2O is collected along with the CO2. Because direct analytical separation of N2O from CO2 is very difficult, as N2O is isosteric with CO2 and has almost identical physical properties, correction factors are commonly applied to neutralize the effects of N2O contamination. In unsaturated zone gases, CO2 concentrations vary by nearly an order of magnitude from 0.037% to 0.300%; therefore, application of a constant correction factor could result in large errors in isotope ratio. A unique factor to correct carbon and oxygen isotope ratios of CO2 for N2O content is not acceptable for most geochemical samples. These observations led to the development of a method to separate N2O from CO2 without altering the delta-13-C and delta-18-O values of the CO2. Gas chromatographic (GC) separation was employed on a high-vacuum preparation line. Using this technique, the delta-13-C and delta-18-O values after N2O removal were identical within experimental error to those of the CO2 prior to addition of N2O. However, the technique is limited to a maximum sample size of 3 micromol to achieve satisfactory separation. To process samples in the range of 10-15 micromol, the capacity of the column was raised by using a 4 m long, 0.64 cm o.d. column. Separations were achieved such that delta-13-C and delta-18-O values after N2O removal were identical within experimental error to those of the CO2 prior to addition of N2O. The time between peaks (CO2 and N2O) and the collection time of CO2 vary, depending on the column; in this case the collection time was 3 min. (Lantz-PTT)
W91-11804

PROGRAMS AND ANALYTICAL METHODS FOR THE U.S. GEOLOGICAL SURVEY ACID RAIN QUALITY-ASSURANCE PROJECT.
Geological Survey, Denver, CO. Water Resources Div.
R. B. See, T. C. Willoughby, M. H. Brooks, and J. D. Gordon.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4029, 1990. 57p, 3 fig, 15 ref. Project No. QA217.

Descriptors: *Acid rain, *Chemical analysis, *Quality assurance, *Sampling, *Water analysis, Atmospheric wet deposition.

The U.S. Geological Survey operates four programs to provide external quality-assurance of wet deposition monitoring by the National Atmospheric Deposition Program and the National Trends Network. An intersite-comparison program assesses the precision and bias of onsite determinations of pH and specific conductance made by site operators. A blind-audit program is used to assess the effect of routine sample-handling procedures and transportation on the precision and bias of wet-deposition data. An interlaboratory comparison program is used to assess analytical results from three or more laboratories, which routinely analyze wet-deposition samples from the major North American networks, to determine if comparability exists between laboratory analytical results and to provide estimates of the analytical precision of each laboratory. A collocated sampler program is used to estimate the precision of wet/dry precipitation sampling throughout the National Atmospheric deposition Program and the National Trends Network to assess the variability of varying spatial arrays and to evaluate the impact of violations of specific site criteria. This report documents the procedures and analytical methods used in these four quality-assurance programs. (USGS)
W91-11856

BIBLIOGRAPHY ON SAMPLING GROUND WATER FOR ORGANIC COMPOUNDS.
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 5A.
W91-11861

MEASUREMENT OF SOIL STRUCTURE, WATER MOVEMENT AND SOLUTE TRANSPORT USING COMPUTED TOMOGRAPHY.
Missouri Univ., Columbia. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W91-11909

PORTABLE CHAMBER FOR MEASURING ALGAL PRIMARY PRODUCTION IN STREAMS.
Colgate Univ., Hamilton, NY. Dept. of Biology.
R. L. Fuller, and J. B. Bucher.
Hydrobiologia HYDRB8, Vol. 209, No. 2, p 155-159, February 1991. 1 fig, 1 tab, 9 ref, append.

Descriptors: *Algae, *Instrumentation, *Measuring instruments, *New York, *Primary productivity, *Streams, Field tests, Kingsley Creek, Periphyton.

A variety of techniques have been employed to measure primary production in stream ecosystems. A portable chamber that measures net primary production of stream periphyton using a 14C uptake method was developed and its effectiveness assessed in Kingsley Creek, Randallsville, New York. The unique feature of the chamber is that substrates are moved through water at a velocity of 20 cm/sec rather than moving water over substrates. The chamber consists of a plexiglass cylinder that is 9 cm high and 15 cm in diameter. On the top of the cylinder is a DC gearmotor powered by a 12 volt, deep cycle marine battery. The motor turns on a shaft that rotates a 13.3-cm plexiglass plate at a velocity of 20 cm/sec. Small tiles (3.2 cm x 3.2 cm x 0.5 cm) bearing natural algal assemblages are mounted on the rotating plate. After adding 500 ml of filtered stream water and 185 kBq (microcuries) NaH14CO3 to the chamber, the chamber is placed along a stream margin for 5 hr. Measurements of 14C uptake by algae on the tiles provide estimates of net primary production (NPP). A test of the chamber was conducted in open-canopy and closed-canopy stream reaches. In autumn, primary production was higher in the open-canopy section than in the closed-canopy section and NPP was lower in spring in both sections, probably because of scouring of algae due to snowmelt. (Author's abstract)
W91-12094

MESH-SIZE EFFECTS ON DRIFT SAMPLE COMPOSITION AS DETERMINED WITH A TRIPLE NET SAMPLER.
Geological Survey, Menlo Park, CA.
K. V. Slack, L. J. Tilley, and S. S. Kennelly.
Hydrobiologia HYDRB8, Vol. 209, No. 3, p 215-226, February 15, 1991. 4 fig, 4 tab, 59 ref.

Descriptors: *Aquatic drift, *Colorado, *Invertebrates, *Plankton nets, *Samplers, *Sampling, Deer Creek, Lotic environment, Particle size, Performance evaluation.

Nested nets of three different apertures were used to study mesh-size effects on drift collected in a small mountain stream (Deer Creek, near Montezuma, Colorado). The innermost, middle, and outermost nets had, respectively, 425 micrometer, 209 micrometer, and 106 micrometer openings, a design that reduced clogging while partitioning collections into three size groups. The open area of mesh in each net, from largest to smallest mesh opening, was 3.7, 5.7, and 8.0 times the area of the net mouth. During a 2-day period in August 1986, Chironomidae larvae were dominant numerically in all 209-micrometer and 106-micrometer samples and midday 425-micrometer samples. Large drifters (Ephemerellidae) occurred only in 425-micrometer or 209-micrometer nets, but the general pattern was an increase in abundance and number of taxa with decreasing mesh size. Relatively more individuals occurred in the larger mesh nets at night than during the day. The two larger mesh sizes retained 70% of the total sediment/detritus in the drift collections, and this decreased the rate of clogging of the 106-micrometer net. If an objective of a sampling program is to compare drift density or drift rate between areas and sampling dates, the same mesh size should be used for all sample collection and processing. The mesh aperture used for drift collection should retain all species and life stages of significance in a study. The nested net design enables an investigator to test the adequacy of drift samples. (Author's abstract)
W91-12096

COMPARISON OF PCB QUANTITATION METHODS: RE-ANALYSIS OF ARCHIVED SPECIMENS OF HERRING GULL EGGS FROM THE GREAT LAKES.
Canadian Wildlife Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5A.
W91-12143

SURBER AND KICK SAMPLING: A COMPARISON FOR THE ASSESSMENT OF MACROINVERTEBRATE COMMUNITY STRUCTURE IN STREAMS OF SOUTH-WESTERN AUSTRALIA.
Western Australia Univ., Nedlands. Dept. of Zoology.
A. W. Storey, D. H. D. Edward, and P. Gazey.
Hydrobiologia HYDRB8, Vol. 211, No. 2, p 111-121, March 22, 1991. 4 fig, 3 tab, 27 ref.

Descriptors: *Australia, *Kick sampling, *Macroinvertebrates, *Sampling, *Surber sampling, Dundalup River, Ecology, Environmental impact, Performance evaluation, Statistics, Stream ecology.

Macroinvertebrate community structure was compared in benthic samples taken by Surber and kick methods from 11 sites in the Dundalup River basin 100 km south of Perth, Australia. Sampling was conducted concurrently at all sites and took place in winter, spring, and summer of 1987. Surber samples contained fewer individuals and more taxa, particularly those with a low frequency of occurrence. This was attributed to the lower surface area, but greater intensity of Surber sampling. It is proposed that the Surber method is more suited to taking cryptic and closely adherent taxa in sites with a highly heterogeneous substratum. Percentage similarity between paired Surber and kick samples was determined by Sorensen's and Czekanowski's coefficients, with mean values of 66% and 60% for June, 61% and 49% for September, and 66% and 49% for December, respectively. Ordination demonstrated a division of upland from lowland sites on axis 1, with a separation of paired-samples on axis 2. This pattern held across qualitative and quantitative data sets, with and without a downweighting on rare taxa. At each level of classification, fewer paired samples separated in qualitative than quantitative data sets. Kick sam-

pling provided a substantial cost saving compared to Surber sampling, particularly when qualitative data were used, making the method suitable for routine biological monitoring. However, the initial use of replicated Surber sampling, particularly in areas that have not been sampled previously, is recommended for environmental impact studies to detect rare taxa, that may be endangered. (Author's abstract)
W91-12189

CENTRIFUGAL TECHNIQUES FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY.
Geological Survey, Menlo Park, CA. Water Resources Div.
J. R. Nimmo, and K. A. Mello.
Water Resources Research WRERAQ, Vol. 27, No. 6, p 1263-1269, June 1991. 7 fig, 11 ref, append.

Descriptors: *Analytical methods, *Centrifugation, *Hydraulic conductivity, *Instrumentation, *Measuring instruments, *Saturated hydraulic conductivity, *Soil water, Darcys law, Porous media, Soil types.

Centrifugal force is an alternative to large pressure gradients for the measurement of low values of saturated hydraulic conductivity (Ksat). With a head of water above a porous medium in a centrifuge bucket, both constant-head and falling-head measurements are practical at forces up to at least 1800 times normal gravity. Darcy's law applied to the known centrifugal potential leads to simple formulas for Ksat that are anaiogous to those used in the standard gravity-driven constant-head and falling-head methods. Both centrifugal methods were tested on several fine-textured samples of soil and ceramic marterials with Ksat between about 0.1 and 1 nm/s. The results were compared to falling-head gravity measurements. The comparison shows most measurements agreeing to within 20% for a given sample, much of the variation probably resulting from run-to-run changes in sample structure. The falling-head centrifuge method proved to be especially simple in design and operation and was more accurate than the constant-head method. With modified apparatus, Ksat measurements less than 0.1 nm/s should be attainable. (Author's abstract)
W91-12240

GLOBAL PRECIPITATION ESTIMATES FROM SATELLITE: USING DIFFERENCE FIELDS OF OUTGOING LONG-WAVE RADIATION.
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W91-12253

OPTIMUM GEOMETRY OF RADIOACTIVE AQUEOUS SAMPLE CONTAINER FOR MEASUREMENT WITH A GERMANIUM DETECTOR.
National Tsing Hua Univ., Hsinchu (Taiwan). Inst. of Nuclear Science.
For primary bibliographic entry see Field 5A.
W91-12277

PREDICTING WATER CONSUMPTION FROM HOMEOWNERS' ATTITUDES.
For primary bibliographic entry see Field 6D.
W91-12287

COMPARISON OF FOUR METHODS FOR MEASURING CHITINASE ACTIVITY AND THE APPLICATION OF THE 4-MUF ASSAY IN AQUATIC ENVIRONMENTS.
University of West Florida, Pensacola. Dept. of Biology.
M. A. Hood.
Journal of Microbiological Methods JMIMDQ, Vol. 13, No. 2, p 151-160, June 1991. 4 fig, 1 tab, 19 ref. EPA Contract 68-03-3479.

Descriptors: *Aquatic environment, *Biodegradation, *Chitinase, *Enzymes, *Laboratory methods, Biochemistry, Comparison studies, Fluorescence.

Four methods were compared for measuring chitinase activity in natural aquatic environments and microcosms. The four methods included: (1) the enumeration of chitinoclastic microorganisms; (2) the use of chitin azure as a substrate; (3) the use of fluorogenic (4-methylumbelliferyl (4-MUF)) chitin derivatives as substrates; and (4) the use of 3-H-chitin as a substrate. The 4-MUF assay required the least amount of preparation, the shortest time to complete, and was one of the most sensitive and highly reproducible assays. Optimum assay conditions included: (1) concentration of the trimer (4-MUF-beta-D-N,N',N" triacetylchitotriose) at 5 microM/mL; (2) pH at 7.4; (3) temperature 35 C; (4) time at 24 hr; and (5) final pH after incubation adjusted to 10-11 (to enhance fluorescence). Using this method, chitinase activity was determined to be highest in the aerobic region of aquatic sediments, slightly lower in the anaerobic zone, and lowest in the water column (5% of the total activity). The majority of enzymatic activity in sediments was associated with organic particles (95%) while 5% was associated with inorganic matter (sand). The results suggest that the 4-MUF assay is a sensitive, reliable, easily applied method for measuring chitinase activity in aquatic environments. (Author's abstract)
W91-12307

CONSEQUENCES OF PH MEASUREMENT ERRORS.
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV. Environmental Programs Office.
R. Hoenicke, M. A. Stapanian, L. J. Arent, and R. C. Metcalf.
Freshwater Biology FWBLAB, Vol. 25, No. 2, p 261-278, April 1991. 9 fig, 2 tab, 67 ref. EPA Contract No. 68-03-3249.

Descriptors: *Acid rain, *Error analysis, *Hydrogen ion concentration, Acidification, Errors, Measuring instruments, Monitoring, Prediction, Water analysis.

The pH range over which the effects of acidification on freshwater organisms become apparent may be quite narrow, in some cases less than half a pH unit. Therefore, accurate measurement is important, particularly in dilute surface waters near the biologically critical threshold of hydrogen ion activity. A hypothetical example based on data from two species of fish illustrates the potential errors in predicting mean mortality when pH is measured by probes of varying accuracies, placing the results into an ecosystem management perspective. For a given error, there will be greater uncertainty in predicting mean mortality for species sensitive to increased pH than for more tolerant species. Field pH measurement errors, and present unique laboratory (measurements at 1 C and under argon) and field comparisons of current instruments used for continuous, in situ pH monitoring, including the only instrument comparison in low conductivity waters during snowmelt, are reviewed and presented. Four operator or sampler-caused measurement errors and three electrode-caused pH measurement errors are illustrated with data from four common types of pH probes and meters. Studies providing no confidence intervals for a set of pH measurements due to the lack of rigorous quality control and assurance procedures are of limited quantitative value to future investigators attempting to analyze temporal trends of surface water acidification. Management and policy decision attempts will remain seriously hampered until more interpretable results are routinely generated. (Author's abstract)
W91-12310

DETERMINATION OF MONOCYCLIC AND POLYCYCLIC AROMATIC HYDROCARBONS IN FISH TISSUE.
National Fisheries Contaminant Research Center, Columbia, MO.
For primary bibliographic entry see Field 5A.
W91-12353

ACCURACY OF SELECTED TECHNIQUES FOR ESTIMATING ICE-AFFECTED STREAMFLOW.
Geological Survey, Madison, WI.
J. F. Walker.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 6, p 697-712, June 1991. 3 fig, 6 tab, 17 ref, append.

Descriptors: *Estimating, *Flow equations, *Hydrography, *Ice, *Stream gaging, *Streamflow, Analysis of variance, Comparison studies, Flow discharge, Iowa, Predicting, Simulation, Statistical analysis, Streamflow data.

Techniques for estimating streamflow during ice-affected periods are classified into two categories (subjective and analytical) depending on the degree of judgment required. Discharge measurements were made at three streamflow-gauging sites in Iowa during the winter of 1987-1988 and used to establish a baseline streamflow record for each site. Using data based on a simulated 6-week field trip schedule, selected techniques were used to estimate discharge during the ice-affected periods. For the subjective techniques, three hydrographers independently compiled each record. Three measures of performance were used to compare the estimated streamflow records with the baseline streamflow records: the average discharge for the ice-affected period, and the mean and standard deviation of the daily errors. Based on average ranks for three performance measures at the three sites, the analytical and subjective techniques are essentially comparable. For two of the three sites, Kruskal-Wallis one-way analysis of variance detected significant differences among the three hydrographers for the subjective methods, indicating that the subjective techniques are less consistent than the analytical techniques. Results suggest that analytical techniques may be viable tools for estimating discharge during periods of ice effect, and should be developed further and evaluated for sites across the United States. (Author's abstract)
W91-12356

TIME DISTORTION IN LARGE SCALE SEDIMENT MODEL TESTS.
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
For primary bibliographic entry see Field 2J.
W91-12365

AUTOMATIC MEASUREMENT OF BOUNDARY SHEAR STRESS AND VELOCITY DISTRIBUTIONS IN DUCT FLOW.
Cranfield Inst. of Tech. (England). School of Mechanical Engineering.
For primary bibliographic entry see Field 2E.
W91-12366

SAMPLING PERFORMANCE OF EKMAN GRABS--IN SITU OBSERVATIONS AND DESIGN IMPROVEMENTS.
Askoe Lab., Stockholm (Sweden).
S. Blomqvist.
Hydrobiologia HYDRB8, Vol. 206, No. 3, p 245-254, October 29, 1990. 8 fig, 1 tab, 38 ref.

Descriptors: *Benthic fauna, *Biological samples, *Bottom sampling, *Ekman grab samplers, *Samplers, Bottom sediments, Design criteria, In situ tests, Performance evaluation, Testing procedures.

The performance of five types of Ekman grab: the Birge-Ekman, the Kebo Lab-Ekman, the Hydro-Bios-Ekman, the Winnepeg-Ekman and the Hakanson-Ekman, were examined in situ by SCUBA diving. Trials and observations were conducted, and photographic documentation was taken. Each type of grab often produced unrepresentative samples due to operation deficiencies. Tilting, brimming, and entry of sediment from outside the sample chamber, as well as redistribution, resuspension and loss of enclosed matter were the main biasing factors. Since the grabs under study were models in general use, these findings suggest that caution must be exercised when evaluating studies based on Ekman grabs of the usual design. Sam-

pling reliability can be significantly improved by furnishing the grabs with a supporting stand and a mechanism which secures the lids during ascent. Designs for such devices were tested. A properly operated Ekman grab of adequate design is a suitable instrument for collecting certain types of samples, such as benthic macrofauna and in fauna. (Author's abstract)
W91-12386

AIRCRAFT MULTIFREQUENCY PASSIVE MICROWAVE OBSERVATIONS OF LIGHT PRECIPITATION OVER THE OCEAN.
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
R. F. Adler, and I. M. Hakkarinen.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 8, No. 2, p 201-220, April 1991. 18 fig, 30 ref.

Descriptors: *Meteorology, *Microwaves, *Precipitation, *Radiation, *Remote sensing, Clouds, Infrared imagery, Oceans, Radar, Rain, Rainfall, Temperature, Weather.

Aircraft passive microwave observations at 18, 37, 92 and 183 GHz of light oceanic precipitation were studied in conjunction with visible and infrared observations and ground-based radar data. Microwave signatures for clear, cloudy, and precipitating conditions were defined, with results in general agreement with previous theoretical results. Emission signatures were evident at 18, 37 and 92 GHz with clouds and precipitation producing an increase in brightness temperature over that observed over the low-emissivity ocean background. Polarization differences at 18 and 37 GHz also decreased in precipitation areas to minima of 30 Kelvin at 18 GHz and 15 Kelvin at 37 GHz. The 92-GHz brightness temperature showed a double-valued relationship, with an increase in cloudy and very lightly raining areas and a subsequent decrease for higher rain rates and deeper clouds where the ice scattering process becomes important. The 183-GHz observations displayed a distinct sensitivity to small amounts of ice. Simple channel differences were shown to compare favorably to the rain field, including polarization differences at 18 and 37 GHz and frequency differences between 92 and 37 GHz and between 183 and 92 GHz. The cases examined include both stratiform and convective structures, with results indicating that this difference may be important in microwave brightness temperature-rain rate relationships. Some of the observed differences may also be due to the presence or absence of a melting layer, observed as a radar bright band. (Author's abstract)
W91-12387

RAINFALL PARAMETER ESTIMATION FROM DUAL-RADAR MEASUREMENTS COMBINING REFLECTIVITY PROFILE AND PATH-INTEGRATED ATTENUATION.
Communications Research Lab., Tokyo (Japan).
For primary bibliographic entry see Field 2B.
W91-12388

ROLE OF BACTERIA IN THE NORTH SEA ECOSYSTEM.
Brussels Univ. (Belgium).
For primary bibliographic entry see Field 2L.
W91-12394

HYDROMETEOROLOGICAL FORECASTING AND REMOTE CONTROL AT ELECTRICITE DE FRANCE (PREVISION ET TELESURVEILLANCE HYDROMETEOROLOGIQUE A EDF).
Electricite de France, Grenoble. Div. Technique.
P. Tourasse.
Houille Blanche HOBLAB, Vol. 1991, No. 2, p 149-154, 1991. English summary.

Descriptors: *Forecasting, *Hydroelectric powerplants, *Hydrometeorology, *Remote control, *Streamflow forecasting, *Water resources management, Automation, Computers, Hydrologic data, Model studies, Rainfall-runoff relationships, Satellite technology.

The use of the Public Telephone Network and, in some cases, of satellites (ARGOS or METEOSAT) is of great interest for real-time hydrological data collection, especially for the management of power production and distribution systems. This use would allow for a central automatic collection of basic hydrological information--more than 400 points are already telemetered at EDF by the SCHTROUMPH system--as well as the local operation of reservoirs during flood periods through the use of an Automatic Collection Station and a micro-computer to interrogate these measurements at peripheral stations. In some cases, stochastic models for treating rainfall-runoff processes--but also quantitative rainfall and/or air temperature forecasts--can be used to anticipate the evolution of these parameters. Even if they need sophisticated identification techniques, these models are easy to install on microcomputers. However, they are still only decision tools, and have to be disconnected from automatic operating processes. (Author's abstract)
W91-12420

CONTINUOUS FLOW THIN-LAYER HEADSPACE (TLHS) ANALYSIS: II. SPECTROPHOTOMETRIC DETERMINATION OF VOLATILE ORGANIC HALOGENS (VOX) IN WATER.
Gdansk Technical Univ. (Poland). Inst. of Inorganic Chemistry and Technology.
For primary bibliographic entry see Field 5A.
W91-12439

ASSESSMENT OF EXTRACTION METHODOLOGIES FOR MEASURING SUBSURFACE CONTAMINATION.
Gradient Corp., Cambridge, MA.
For primary bibliographic entry see Field 5A.
W91-12477

CALIBRATION AND VALIDATION OF TAP, AN AQUACULTURE POND WATER QUALITY MODEL.
California Univ., Davis. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W91-12494

LOSS ON IGNITION AND KJELDAHL DIGESTION FOR ESTIMATING ORGANIC CARBON AND TOTAL NITROGEN IN ESTUARINE MARSH SOILS: CALIBRATION WITH DRY COMBUSTION.
Duke Univ., Durham, NC. Duke Environmental Center.
C. B. Craft, E. D. Seneca, and S. W. Broome.
Estuaries ESTUDO, Vol. 14, No. 2, p 175-179, June 1991. 3 fig, 2 tab, 29 ref.

Descriptors: *Chemical analysis, *Estuaries, *Kjeldahl procedure, *Marshes, *Nitrogen, *Organic carbon, *Soil chemistry, Detritus, North Carolina, Organic matter, Regression analysis, Soil properties, Wetlands.

Soils (n=250) were collected from ten salt and brackish-water marshes of North Carolina and analyzed for organic matter content by loss on ignition (LOI) and Kjeldahl nitrogen (KN). Total organic carbon and total nitrogen were determined on the same samples using an elemental CHN analyzer. Regression analyses indicated that LOI and KN were excellent estimators of organic C and total N, in low clay content (0-11%) marsh soils containing a wide range of soil organic C (0.1-28%) and total N (0-1.6%). A quadratic equation best described the relationship between organic C and organic matter (Organic C=0.40 (LOI) + 0.0025 (LOI)squared) while a linear model accurately described the relationship between total N and Kjeldahl N (Total N=1.048 (KN)-0.010). The proportion of organic C in organic matter (C/OM) increased with increasing soil organic matter content, probably as a result of aging. Young marshes, which are characterized by low soil organic content contain C/OM ratios similar to emergent vegetation (40-45%). In old organic soils (70-80% organic matter), C/OM increased to 57-60% due to accumulation of reduced organic materials. (Author's abstract)
W91-12501

PHYSICAL MEASUREMENTS IN SUBSURFACE HYDROLOGY.
Auburn Univ., AL.
For primary bibliographic entry see Field 2F.
W91-12512

SIMULTANEOUS DETERMINATION OF INORGANIC ARSENIC AND ANTIMONY SPECIES IN NATURAL WATERS USING SELECTIVE HYDRIDE GENERATION WITH GAS CHROMATOGRAPHY/PHOTOIONIZATION DETECTION.
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
For primary bibliographic entry see Field 5A.
W91-12537

LIQUID CHROMATOGRAPHIC DETERMINATION OF LINEAR ALKYLBENZENESULFONATES IN AQUEOUS ENVIRONMENTAL SAMPLES.
Rome Univ. (Italy). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W91-12538

CONFIDENCE INTERVAL FOR DESIGN FLOODS WITH ESTIMATED SKEW COEFFICIENT.
Institute of Flood Control and Drainage Research, Dacca (Bangladesh).
For primary bibliographic entry see Field 2E.
W91-12559

REMOTE DETERMINATION OF SOIL MOISTURE AND EVAPOTRANSPIRATION FROM THERMAL INFRARED MEASUREMENTS: DETECTION OF A DRYING THRESHOLD.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
For primary bibliographic entry see Field 2D.
W91-12628

TECHNIQUES FOR COMPUTING DISCHARGE AT FOUR NAVIGATION DAMS ON THE ILLINOIS AND DES PLAINES RIVERS IN ILLINOIS.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-12655

ANALYSIS OF PHYTOPLANKTON SIZE USING OPTICAL FIBER CABLES WITH THE LASER TECHNIQUE.
Kinki Univ., Higashiosaka (Japan). Dept. of Fisheries.
For primary bibliographic entry see Field 2H.
W91-12742

SURVEY OF ALGAL PICOPLANKTON FROM LAKES IN FIVE CONTINENTS.
Durham Univ. (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-12768

SURFACE WATER ACIDIFICATION: A COMPARISON OF METHODS FOR PH DETERMINATION IN WEAKLY BUFFERED NATURAL WATERS.
Freiburg Univ. (Germany, F.R.). Inst. fuer Physische Geographie.
H. Meesenburg.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1255-1258, March 1991. 4 fig, 1 tab, 13 ref. Federal Environmental Agency Project No. 102 04 342.

Descriptors: *Acid rain, *Acidification, *Chemical analysis, *Experimental design, *Hydrogen ion

concentration, *Laboratory methods, *Surface water, *Water analysis, Black Forest, Buffer capacity, Comparison studies, Germany, Water sampling.

A reliable and reproducible method for pH determination is required, since pH measurements are also used for potentiometric titrations and for the calculation of proton concentrations. The effect of storage times of water samples and of the addition of KCl on pH of weakly buffered surface waters of the Black Forest, Germany, was studied. Comparison of field and laboratory measurements of pH exhibited lower values of pH in the laboratory (by an average of 0.16 units) for most samples. The addition of KCl caused a decrease of pH in most samples, which is a function of the organic content and of the pH of the samples. Although the changes in pH due to the addition of Kcl are ot very drastic and are within the range usually given as error in pH measurements, they are systematic errors and the application of Kcl should be noted in pH determinations. (Brunone-PTT)
W91-12775

CONTINUOUS FLOW-SYSTEM TO MEASURE PHYTOPLANKTON PHOTOSYNTHESIS.
Roskilde Universitetscenter (Denmark). Inst. of Life Sciences and Chemistry.
A. M. Jespersen.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1260-1262, March 1991. 2 fig, 1 tab, 9 ref.

Descriptors: *Algal growth, *Chlorophyta, *Experimental design, *Laboratory methods, *Limnology, *Photosynthesis, *Phytoplankton, *Primary productivity, *Respiration, Bacteria, Carbon radioisotopes, Chlorophyll a, Culturing techniques, Oxygen requirements, Scenedesmus.

A continuous flow-system was developed to make simultaneous measurements of photosynthesis and dark respiration by carbon-14, carbon-12 and oxygen in laboratory cultures of axenic freshwater algae. The experimental system makes possible the relatively constant maintenance of growth conditions and the comparison of carbon-14 uptake rates with other metabolic estimates. Experiments were performed with the freshwater chlorophyte Scenedesmus quadricauda. To eliminate bacteria, the algae were grown in sterile Z8 medium to which was added the antibiotic Kanamycin. The experimental system for continuous measurements of production and growth consists of an incubation chamber, a medium-reservoir connected by air tight tubings to the chamber, and a filter in front of the outlet. The algae culture was kept in suspension. Oxygen concentration was continuously recorded with the oxygen electrode. The measured carbon-14 uptake in light showed a slight overestimation compared with the carbon-12 determined net photosynthesis, with a carbon-14:carbon-12 ratio of 0.88. The oxygen production in light agreed closely with the carbon-14 estimates and almost identical averages were obtained. A photosynthetic quotient of 1.07 was obtained when using the carbon-12 estimates. The chlorophyll a concentration increased from 873 to 1103 microg/L. In the described flow-system an experiment can be maintained without problems for at least 12 hours. The system is not applicable to very low algae concentrations due to the sensitivity of the method. With the flow-system, comparison studies can be carried out with good temporal resolution and without interference from changes in pH, inorganic carbon and nutrient concentrations. (Brunone-PTT)
W91-12776

C-14 UPTAKE AND GROWTH RATE OF PHYTOPLANKTON IN CONTINUOUS CULTURES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
G. Ahlgren.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 1263-1267, March 1991. 2 fig, 3 tab, 13 ref.

Descriptors: *Algal growth, *Carbon radioisotopes, *Culturing techniques, *Experimental design, *Laboratory methods, *Limnology, *Phytoplankton, Hydrogen ion concentration, Scenedesmus, Water temperature.

The hypothesis that at steady state growth carbon-14 uptake should give good estimates of algal growth rates even at short incubation times was tested on monospecific continuous cultures of Scenedesmus quadricauda. The carbon-14 uptake gave good estimates in many of the experiments at 15, 20 and 30 C, but both overestimates and underestimates occurred. The overestimates occurred at high pH (>10.0) and were very likely caused by erratic dissolved inorganic carbon values at that pH. The underestimates occurred mostly at the lowest temperature (10 C), with no explanation. The carbon-14 uptake can give satisfactory estimates of growth rates even at short incubation time (1 or 2 hours) if the algae are growing at steady state conditions and in moderate temperatures. The results show that unrealistic results based on the carbon-14 method can depend on inaccurate estimation of other quantities used rather than on the carbon-14 method. (Brunone-PTT)
W91-12777

DISCREPANCIES BETWEEN O2- AND 14C-METHOD RESULTING FROM MEASUREMENTS OF PRIMARY PRODUCTION UNDER CONSIDERATION OF VERTICAL MIXING IN A SHALLOW EUTROPHIC LAKE.
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
For primary bibliographic entry see Field 2H.
W91-12778

IMPROVEMENT IN ACCURACY OF THE INTERPRETATION OF ALGAL GROWTH CURVES USING A 200 CHANNEL AUTOMATIC BATCH CULTURE APPARATUS.
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W91-12779

ALGAL-CONSUMER INTERACTIONS IN 2-STAGE CONTINUOUS CULTURE SYSTEMS.
Michigan Univ., Ann Arbor. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W91-12780

ESTIMATING OIL AND GREASE CONTENT OF PETROLEUM-CONTAMINATED SOIL.
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 5A.
W91-12818

USE OF PROTOZOA TO INDICATE CHANGES IN THE PERFORMANCE OF ACTIVATED SLUDGE PLANTS.
Leeds Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-12848

SIGNIFICANCE OF SEVERAL BACTERIOPHAGE GROUPS AS INDICATORS OF SEWAGE POLLUTION IN MARINE WATERS.
Malaga Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W91-12852

EFFECTS OF SAMPLING TECHNIQUES ON THE GAMMARUS:ASELLUS RATIO.
Brighton Polytechnic (England). Dept. of Civil Engineering.
I. T. Whitehurst.
Water Research WATRAG, Vol. 25, No. 6, p 745-748, June 1991. 4 tab, 11 ref.

Descriptors: *Amphipods, *Analytical methods, *Bioindicators, *Biological samples, *Isopods, *Microbiological studies, *Sampling, Airbrick sampling, Artificial substrates, Basket sampling, Standard Aufwuchs Unit, Stream biota, Water quality monitoring, Water sampling.

Previous studies have shown the Gammarus:Asellus ratio to be useful in assessing organic enrichment in lowland rivers. Conventional sampling nets used in conjunction with handlifting of stones or kicking the substratum directly in front of the net have been effective in shallow water riffles. Differing conditions of water velocity, depth, temperature and the nature of the substratum, however, may affect sampling efficiency. The results obtained using conventional sampling techniques vary a great deal. Three types of artificial substratum colonization sampler (for example, Standard Aufwuchs Unit), airbrick and basket samplers containing graded stones were compared with conventional Surber direct sampler data to determine the effects of passive sampling techniques on the ratio. Sampling sites were selected both upstream and downstream of the Burgess Hill wastewater effluent discharge points on the River Adur, Sussex, England and on one clean tributary, the Chess Stream. The Standard Aufwuchs Unit and airbrick substratum colonization samplers provided Gammarus:Asellus ratios that showed some correspondence with the ratios derived from Surber data and performed well in the assessment of water quality at all sites. Basket samplers were found to have some degree of selectivity, particularly by Gammarus, for substrata having sizes of interstices corresponding with body size. The results from the basket sampler data therefore were inconclusive as colonization of these types of samplers are affected by factors other than pollution. (Mertz-PTT)
W91-12860

NEW METHOD FOR MEASURING THE HARDNESS OF WATER.
Humboldt-Univ. zu Berlin (German D.R.). Fachbereich Chemie der.
For primary bibliographic entry see Field 2K.
W91-12865

INFLUENCE OF OPERATOR POSITION ON THE PRECISION OF MEASUREMENTS TAKEN WITH HAND-HELD VELOCITY METERS IN RIVERS.
Utah Cooperative Fishery and Wildlife Research Unit, Logan.
T. Modde, and B. Platz.
North American Journal of Fisheries Management NAJMDP, Vol. 10, No. 2, p 247-248, Spring 1990. 1 fig, 2 ref.

Descriptors: *Data acquisition, *Flow velocity, *Flowmeters, *Measuring instruments, *River flow, *Stream gaging.

Measurements of water velocity with electromagnetic instruments mounted on wading rods have been reported to be most accurate when the operator is positioned to the side, and downstream from the meter. Measurements taken in a large river from several positions lateral and downstream from the meter at different ranges of velocity, indicated that no differences occurred among positions, and that all positions represented accurate estimates. (Author's abstract)
W91-12895

RESULTS OF A LABORATORY EXPERIMENT RELATING SPECTRAL REFLECTANCE TO TOTAL SUSPENDED SOLIDS.
Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
E. M. L. M. Novo, C. A. Steffen, and C. Z. F. Braga.
Remote Sensing of the Environment RSEEA7, Vol. 36, No. 1, p 67-72, April 1991. 4 fig, 27 ref. FAPESP Grant No. 88/4016-5 and CNPq Grant No. 820260/894.

Descriptors: *Laboratory methods, *Light attenuation, *Limnology, *Reflectance, *Spectral analy-

sis, *Suspended solids, Optical properties, Physical properties, Remote sensing, Water quality.

Scattering by suspended solids plays a major role in the vertical attenuation of light in continental waters. Light attenuation is an important factor regulating physical and biological processes in aquatic systems, because it affects the vertical thermal structure and mixing, and it regulates phytoplankton production. Total suspended solids (TSS) concentration is, therefore, one of the basic parameters for limnological characterization of aquatic ecosystems. A laboratory experiment was performed to chose optimal wavelengths for the estimation of TSS from remotely sensed water reflectance. The experimental method involves the determination of water reflectance as produced by the simulation of different TSS concentrations. Results for the oxisoil sediment used in the experiment showed a linear correlation between spectral reflectance and TSS concentration. The water residual spectral reflectance factor proved to be sensitive to changes in TSS concentration in the range of 400-900 nm. A linear relationship was found between spectral residual reflectance and the oxisoil-derived TSS. The correlation coefficient was statistically significant and constant in the spectral range of 480-900 nm. The regression coefficient, which indicates the sensitivity of spectral residual reflectance to changes in TSS concentration, peaked at the red wavelengths. These experimental results suggest that sensitivity of the reflectance factor to the TSS concentration tends to match the band of maximum dry sediment reflectance. (Lantz-PTT)
W91-12898

EVALUATION OF THE INHIBITORY EFFECTS OF LITHIUM WHEN USED AS A TRACER FOR ANAEROBIC DIGESTERS.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-12904

WATER AND LAND USE AND REMOTE SENSING.
Corps of Engineers, Washington, DC.
E. O. Gangstad.
IN: Natural Resource Management of Water and Land. Van Nostrand Reinhold, New York. 1990. p 57-71, 2 fig, 1 tab, 7 ref.

Descriptors: *Land use, *Landsat images, *Microwaves, *Remote sensing, *Water resources management, *Water use, Databases, Information retrieval, Runoff forecasting, Water quality, Water resources data.

Remote sensing tools generally consist of the following components: (1) a platform to carry the sensing equipment and a power supply; (2) the sensor itself, which detects some portion of the electromagnetic spectrum reflected or emitted by the object being studied; (3) communications equipment to transmit the sensor signal; and (4) processing equipment which converts transmissions into understandable data. Landsat data is now used to measure surface area and microwaves, with their unique ability to penetrate water vapor, will provide depth and density data. Together these can be used to provide volumetric parameters for runoff estimates. The range of observables is surprisingly large, much greater than is immediately apparent. The trained observer learns to read indirect signs of water such as the presence of bankside vegetation to indicate a stream too small to be directly observed, geological structures indicating the presence of underground water sources, and water consumption indicated in photos of irrigated cropland. Water quality is more difficult to detect but some parameters such as turbidity correlate well with values derived by direct observation and have been of value in locating sources of pollution. The Bureau of Land Management has developed a long-term plan to create a resource data base to assist its resource managers. Orders for reproductions of data from the EROS data Center are accepted from individuals, governmental organizations, universities, and industries in U.S. and foreign countries. (See also W91-12922) (Doyle-PTT)
W91-12927

7C. Evaluation, Processing and Publication

DEVELOPMENT OF A PROCESS ORIENTED CALIBRATION SCHEME FOR THE HBV HYDROLOGICAL MODEL.
Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
For primary bibliographic entry see Field 2E.
W91-11658

HEURISTIC OPERATING POLICIES FOR RESERVOIR SYSTEM SIMULATION.
Worcester Polytechnic Inst., MA. Dept. of Management.
For primary bibliographic entry see Field 4A.
W91-11721

DRAINAGE NETWORKS FROM GRID DIGITAL ELEVATION MODELS.
James Madison Univ., Harrisonburg, VA. Dept. of Mathematics and Computer Science.
For primary bibliographic entry see Field 2E.
W91-11724

STOCHASTIC DYNAMIC PROGRAMMING FOR RESERVOIR OPTIMAL CONTROL: DENSE DISCRETIZATION AND INFLOW CORRELATION ASSUMPTION MADE POSSIBLE BY PARALLEL COMPUTING.
Politecnico di Milano (Italy). Dipt. di Elettronica.
For primary bibliographic entry see Field 4A.
W91-11726

RECIPROCITY PRINCIPLE AND AN ANALYTICAL SOLUTION FOR DARCIAN FLOW IN A NETWORK.
British Geological Survey, Wallingford (England).
For primary bibliographic entry see Field 2F.
W91-11727

ESTIMATION OF PARAMETERS FOR FREQUENCY DOMAIN MODELS.
Wright State Univ., Dayton, OH. Dept. of Geological Science.
For primary bibliographic entry see Field 2F.
W91-11741

MODELING THE HYDROGEOCHEMICAL RESPONSE OF A STREAM TO ACID DEPOSITION USING THE ENHANCED TRICKLE-DOWN MODEL.
Connecticut Univ., Storrs. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-11758

REANALYSIS OF DATA SUPPORTING U.S. FEDERAL BACTERIOLOGICAL WATER QUALITY CRITERIA GOVERNING MARINE RECREATIONAL WATERS.
For primary bibliographic entry see Field 5G.
W91-11762

AT-SITE FLOOD FREQUENCY ANALYSIS FOR THAILAND.
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 2E.
W91-11770

ESTIMATION OF POLLUTANT LOADS WITH FUZZY SETS.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-11784

METHOD OF LOWER-BOUND TO ESTIMATE THE PARAMETERS OF A PEARSON TYPE III DISTRIBUTION.
Chengdu Univ. of Science and Technology (China).
B. Wu, Y. Hou, and J. Ding.
Hydrological Sciences Journal HSJODN, Vol. 36, No. 3, p 271-280, June 1991. 1 fig, 2 tab, 5 ref, append.

Descriptors: *Data interpretation, *Flood frequency, *Frequency analysis, *Pearson distribution, *Statistical analysis, *Statistical methods, Distribution analysis, Mathematical studies, Monte Carlo method.

A new procedure, the method of lower-bound (MLB), is proposed for determining the design quantile Xp. The basic concept is first to determine an estimate a'o of the location parameter ao using the probability weighted moment (PWM) method; this is then transformed with the variable X from the original (X) space to a new (Y) space by using Y = X-a'o. The variable Y is considered to have a two parameter gamma distribution. In Y-space, the two parameters are estimated by the PWM or an autocovariance method, then transformed from the Y-space to the X-space. Results from the Monte Carlo experiments show that the MLB estimates are less biased than comparable moment estimates and maximum likelihood estimates, and more efficient than those of PWM for design quantiles Xp. (Author's abstract)
W91-11797

SHORT TERM FORECASTING OF CLOUD AND PRECIPITATION.
Air Force Geophysics Lab., Hanscom AFB, MA.
For primary bibliographic entry see Field 2B.
W91-11830

LOW-FLOW CHARACTERISTICS OF STREAMS IN VIRGINIA.
Geological Survey, Richmond, VA.
For primary bibliographic entry see Field 2E.
W91-11835

PRELIMINARY MAP SHOWING LOCATIONS OF LANDSLIDES IN EL YUNQUE QUADRANGLE, PUERTO RICO.
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 2J.
W91-11837

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, SEPTEMBER 1989.
R. T. Burtell.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225. USGS Open-File Report 90-188, 1990. 1 map (sheet). Prepared in cooperation with the St. Johns River Water Management District, the South Florida Water Management District, and the Southwest Florida Water Management District.

Descriptors: *Aquifers, *Florida, *Floridan Aquifer, *Groundwater level, *Maps, *Potentiometric surface, Aquifer systems, Artesian head, Groundwater management, Potentiometric level, Water districts.

A map has been made of the potentiometric surface of the Upper Floridan Aquifer in September 1989 covering northeastern and central Florida, including the St. Johns River Water Management District, the South Florida Water Management District, and the Southwest Florida Water Management District. The potentiometric contours are generalized to portray synoptically the head in a dynamic hydrologic system taking due account of the variations in hydrogeologic conditions such as differing depths of wells, nonsimultaneous measurements of water levels, variable effects of pumping, and changing climatic influence. The potentiometric contours thus may not conform exactly

with individual measurements of water level. Within the St. Johns River Water Management District, the potentiometric surface ranges from 60 feet below the National Geodetic Vertical Datum of 1929 (NGVD) at Fernandina Beach in the north to >120 feet above NGVD in the south. In the portion of the Southwest Florida Water Management District that was mapped, the range is between 2 feet above NGVD at the Crystal River to 130 feet above NGVD in the south. In the northernmost portion of the South Florida Water Management District, the range is from <30 to >115 feet above NGVD. (Fish-PTT)
W91-11839

POTENTIOMETRIC SURFACE OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, SEPTEMBER 1989.
Geological Survey, Baton Rouge, LA. Water Resources Div.
L. A. Knochenmus, and G. L. Barr.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225. USGS Open-File Report 90-134, 1990. 1 map (sheet), 4 fig, 5 ref. Prepared in cooperation with the Southwest Florida Water Management District.

Descriptors: *Aquifer characteristics, *Aquifers, *Florida, *Groundwater level, *Maps, *Potentiometric surface, Aquifer systems, Artesian head, Groundwater management, Hydrographs, Potentiometric level, Water districts, Water level fluctuations.

The intermediate aquifer system within the Southwest Florida Water Management District underlies a 5,000-sq-mi area of DeSoto, Sarasota, Hardee, Manatee, and parts of Charlotte, Hillsborough, Highlands, and Polk Counties. The potentiometric surface of the intermediate aquifer system was mapped by determining the altitude of water levels in a network of wells and is represented on maps by contours. The maps show water level conditions near the end of the summer rainy season when groundwater withdrawals are usually low and the potentiometric surface is near its highest level for the year. The composite potentiometric surface of all water-bearing units within the intermediate aquifer system was mapped. The hydrographs for selected wells indicate that the annual and seasonal fluctuations of the water levels are generally large where water demand for irrigation is high during the dry season in the central interior region. Fluctuations are smaller in the northern recharge area and in coastal areas where water use is predominantly for public supply. Water levels measured in September 1989 for the composite intermediate aquifer potentiometric surface averaged about 9 ft higher than those measured in May 1989. The largest rise occurred in Hardee County as a result of recharge and reduced groundwater withdrawals for irrigation. September 1989 water levels for the composite intermediate aquifer potentiometric surface averaged about 4 ft lower than the September 1988 levels reported. Cones of depression are evident at Sarasota City well field and the Cape Coral well field and at Mineral Springs, which is a discharge point from the Tamiami-upper Hawthorn aquifer. (Fish-PTT)
W91-11842

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, SEPTEMBER 1989.
Geological Survey, Baton Rouge, LA. Water Resources Div.
L. A. Knochenmus, and G. L. Barr.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225. USGS Open-File Report 90-133, 1990. 1 map (sheet) 3 fig, 3 ref. Prepared in cooperation with the Southwest Florida Water Management District.

Descriptors: *Aquifer characteristics, *Aquifers, *Florida, *Floridan Aquifer, *Groundwater level, *Maps, *Potentiometric surface, Aquifer systems, Groundwater management, Hydrographs, Water districts, Water level fluctuations.

The potentiometric surface of the Upper Floridan aquifer was mapped by determining the altitude of water levels in a network of wells and is represented on maps by contours. The maps show water level conditions near the end of the summer rainy season when groundwater withdrawals are usually low and the potentiometric surface is near its highest level for the year. The hydrographs for selected wells generally indicate that water levels in latitudes north of the Hillsborough-Pasco County line (northern area), where withdrawal is substantially greater, show large annual and seasonal fluctuations. Water levels in most wells measured in September 1989 were higher than those measured in May 1989, except in areas of Pasco County. September water levels averaged about 1 foot higher than May levels in the northern area and about 20 ft higher in the southern area. In the southern area, rises in water levels were about 10 ft or less along coastal and extreme southern regions and about 40 ft in other southern areas. The largest fluctuation of water levels occurred in southern Hillsborough and central Manatee Counties as a result of recharge during the rainy season and reduced groundwater withdrawals for irrigation in the summer. September 1989 water levels averaged about 4 ft lower than the September 1988 levels reported. The decline in water levels during this period was caused largely by below-normal rainfall and reduced recharge to the aquifer from September 1988 through September 1989. (Fish-PTT)
W91-11843

SELECTED DATA DESCRIBING STREAM SUBBASINS IN THE REDWOOD RIVER BASIN, SOUTHWESTERN MINNESOTA.
Geological Survey, St. Paul, MN. Water Resources Div.
D. L. Lorenz, and G. A. Payne.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225. USGS Open-File Report 89-405, 1989. 6p, 1 tab, 1 map (sheet). Prepared in cooperation with the Minnesota Department of Transportation and the U.S. Army Corps of Engineers.

Descriptors: *Geographic information systems, *Maps, *Minnesota, *River basins, *Streamflow data, Catchment areas, Channel flow, Channel storage, Channels, Drainage area, Drainage patterns, Stream discharge, Topographic maps, Watersheds.

Selected data have been used to describe the characteristics of streams upstream from selected points on streams in the Redwood River basin in southwestern Minnesota. The points on the streams include outlets of subbasins of about 5 sq mi sewage treatment plant outlets, and U.S. Geological Survey gaging stations in the basin. 7-1/2 minute-series topographic maps were used as base maps to obtain the data recorded; the drainage area boundaries and stream channels were recorded using a geographic information system (GIS). Database functions and other capabilities of the GIS were used to aggregate the data, determine drainage area of the subbasins, and determine stream channel lengths, lake area, and storage area. The subbasins were delineated on the basis of topographic features and human activities recorded on topographic maps. Data from field inspection and recent drainage ditch maps were transferred to the topographic maps. Drainage basins do not have fixed boundaries. Human activities along basin divides and within the basin, such as the installation of storm sewers, the drainage of wetlands, and the diversion of streams may alter the stream's drainage area. Selected basin characteristics for each of the subbasins in the Redwood River basin include stream rank, indicating the drainage pattern of the stream. The first-ranked river is the Redwood River. (Fish-PTT)
W91-11845

POTENTIOMETRIC-SURFACE MAP OF THE GORDO AQUIFER IN NORTHEASTERN MISSISSIPPI, AUGUST THROUGH DECEMBER 1987.
Geological Survey, Jackson, MS. Water Resources Div.
G. D. S. Goldsmith.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4060, 1990. 1 map (sheet), 3 fig, 9 ref. Prepared in cooperation with the Mississippi Department of Environmental Quality, Bureau of Land and Water Resources.

Descriptors: *Aquifers, *Gordo Aquifer, *Groundwater level, *Maps, *Mississippi, *Potentiometric level, *Potentiometric surface, *Water level fluctuations, Aquifer characteristics, Aquifer systems, Groundwater management, Pumping, Water districts.

Water levels in wells completed in the Gordo aquifer in a 20-county area in northeastern Mississippi are measured at about 5-yr intervals. Data are collected as part of a program to monitor and document the potentiometric surfaces (water levels) of the major aquifers in Mississippi. The third potentiometric-surface map in a series for the Gordo aquifer is based on water-level data collected in 129 wells during August through December 1987. Although contours were based on water-level measurements made during a 5-mo period, the contours are representative because small (less than 5 ft) seasonal changes occurred relative to overall changes. Precipitation on the narrow north-south band of outcrop areas of the Gordo Formation is the primary source of recharge to the Gordo aquifer. Groundwater generally moves downdip to the west and southwest from the outcrop area. Water use from the Gordo aquifer in 1985 was estimated at 43.2 Mgal/d, 2.7% of the total groundwater used in the state. Major water withdrawals from the Gordo aquifer occur at or near the towns of Columbus, Fulton, New Hamilton, Pontotoc, Starkville, Tupelo, and West Point. Potentiometric-surface elevations in the Gordo aquifer generally decrease from the outcrop areas in the northeast to the west and southwest, the direction of regional groundwater flow. The dominant features of the potentiometric surface are cones of depression around the major pumping centers. Changes in the potentiometric surface from 1978 to 1987 indicate that water levels in most wells in the downdip part of the aquifer were substantially lower during August through December 1987 than during September through November 1978. Water levels in wells measured in the aquifer in northeastern Mississippi declined at an average rate of 2 ft/yr between 1978 and 1987, and as much as 100 ft in many wells in and near areas of intensive municipal and industrial pumping. (Fish-PTT)
W91-11846

HYDROGEOLOGY OF THE MIDDLE WILCOX AQUIFER SYSTEM IN MISSISSIPPI.
Geological Survey, Jackson, MS. Water Resources Div.
R. E. Taylor, and J. K. Arthur.
Available from the U.S. Geological Survey, Books and Open-File Reports Section, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4036. 2 maps (sheets), 16 fig, 3 tab, 8 ref.

Descriptors: *Aquifer characteristics, *Aquifer systems, *Groundwater movement, *Mississippi, *Water resources data, *Wilcox Aquifer System, Aquifer management, Groundwater level, Groundwater quality, Groundwater recharge, Potentiometric surface, Water supply development, Wells.

A study has been performed to provide water resource planners and managers with hydrogeologic data on the predominantly undeveloped middle Wilcox aquifer system in Mississippi, and to describe its potential as an alternative source of water. The principal source of recharge to the middle Wilcox aquifer system is from precipitation in the outcrop area, a crescent-shaped belt extending from north to east, and dipping west to southwest. Most of the water that percolates into the ground is lost by evapotranspiration or groundwater discharge to local streams. Locally, the rate and direction of groundwater movement are controlled by the hydraulic conductivity of the sand bed and by withdrawal from wells. The potentiometric surface of the aquifer was mapped to represent the approximate altitude of water levels in wells

screened in the middle Wilcox aquifer system in 1983. Near some pumping centers in and near the recharge area, water-level declines in recent years have been in the range of about 0.5 to 1.0 ft/yr. Generally, however, the middle Wilcox aquifer system is unstressed and no significant cones of depression occur. The aquifer system is capable of yielding 100-500 gpm from large wells; however, the availability of freshwater at shallower depths has limited the development of this aquifer system farther downdip, and results of aquifer tests are sparse. Groundwater in the outcrop area of the aquifer system generally is of a mixed, calcium-sodium bicarbonate type. There is a general trend of increasing pH values and concentrations of dissolved sodium, bicarbonate, nitrate, and iron with increasing depth. Typically, water in the middle Wilcox aquifer system has concentrations much smaller than the recommended limits for drinking water for nitrate, sulfate, and fluoride. Water from this aquifer system is generally suitable for most uses. (Fish-PTT)
W91-11847

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN A PART OF CURRY COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 2F.
W91-11850

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN CENTRAL LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 2F.
W91-11851

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN NORTHERN LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 2F.
W91-11852

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN PORTALES VALLEY, ROOSEVELT COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1989.
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 2F.
W91-11853

PROGRAMS AND ANALYTICAL METHODS FOR THE U.S. GEOLOGICAL SURVEY ACID RAIN QUALITY-ASSURANCE PROJECT.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W91-11856

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990. VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL VALLEY.
Geological Survey, Sacramento, CA. Water Resources Div.
W. F. Shelton, L. F. Trujillo, K. L. Markham, and J. R. Palmer.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-204560. Price codes: A15 in paper copy, A02 in microfiche. USGS Water-Data Report CA-90-2. (USGS/WRD/HD-91/283), 1991. 333p. Prepared in cooperation with the California Department of Water Resources and with other agencies.

Descriptors: *California, *Data collections, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for California consist of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 2 contains discharge records for 125 streamflow-gaging stations and 1 low-flow partial-record station; stage and contents for 7 lakes and reservoirs; precipitation records for 4 stations; and water-quality records for 29 streamflow-gaging stations and 10 water quality partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W91-11881

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990. VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASINS FROM WALKER RIVER TO TRUCKEE RIVER.
Geological Survey, Sacramento, CA. Water Resources Div.
T. C. Hunter, J. R. Mullen, and S. W. Anderson.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-204578. Price codes: A18 in paper copy, A03 in microfiche. USGS Water-Data Report CA-90-3. (USGS/WRD/HD-91/275), 1991. 402p. Prepared in cooperation with the California Department of Water Resources and with other agencies.

Descriptors: *California, *Data collections, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for California consist of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 3 contains discharge records for 181 gaging stations; stage and contents for 52 lakes and reservoirs; water-quality for 36 stations; and 3 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (See also W91-02624) (USGS)
W91-11882

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990. VOLUME 5. GROUND WATER DATA FOR CALIFORNIA.
Geological Survey, Sacramento, CA. Water Resources Div.
J. A. Johnson, L. J. Fong-Frydendal, and J. B. Baker.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-204586. Price codes: A17 in paper copy, A03 in microfiche. USGS Water-Data Report CA-90-5. (USGS/WRD/HD-91/256), 1991. 387p. Prepared in cooperation with other Federal, State and local agencies.

Descriptors: *California, *Data collections, *Groundwater, *Hydrologic data, *Water quality, Chemical analysis, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for California consist of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 5 contains discharge records for 989 observation wells and water quality data for 204 monitoring wells and 2 springs. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W91-11883

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1990. VOLUME 1. MISSOURI RIVER BASIN, ARKANSAS RIVER BASIN, AND RIO GRANDE BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
R. C. Ugland, B. J. Cochran, M. M. Hiner, and R. D. Stegar.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-200626. Price codes: A21 in paper copy, A03 in microfiche. USGS Water-Data Report CO-90-1. (USGS/WRD/HD-91/279), 1991. 489p. Prepared in cooperation with the State of Colorado and other agencies.

Descriptors: *Colorado, *Data collections, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for Colorado for the 1990 water year consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells and springs. This report (Volumes 1 and 2) contains discharge records for 323 gaging stations, stage and contents of 26 lakes and reservoirs, 1 partial-record low-flow station, peak flow information for 40 crest-stage partial record stations, and 1 miscellaneous site; water quality for 141 gaging stations, 179 miscellaneous sites, and 14 observation wells. Seven pertinent stations operated by bordering states also are included in this report. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies. (See also W91-11885) (USGS)
W91-11884

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1990. VOLUME 2. COLORADO RIVER BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
R. C. Ugland, B. J. Cochran, R. G. Kretschman, E. A. Wilson, and J. D. Bennett.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-200626. Price codes: A18 in paper copy, A03 in microfiche. USGS Water-Data Report CO-90-2. (USGS/WRD/HD-91/280), 1991. 394p. Prepared in cooperation with the State of Colorado and other agencies.

Descriptors: *Colorado, *Data collections, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for Colorado for the 1990 water year consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality of wells and springs. This report (Volumes 1 and 2) contains discharge records for 323 gaging stations, stage and contents of 26 lakes and reservoirs, 1 partial-record low-flow station, peak flow information for 40 crest-stage partial record stations, and 1 miscellaneous site; water quality for 141 gaging stations, 179 miscellaneous sites; and for 14 observation wells. Seven pertinent stations operated by bordering states also are included in this report. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies. (See also W91-11884) (USGS)
W91-11885

WATER RESOURCES DATA FOR CONNECTICUT, WATER YEAR 1990.
Geological Survey, Hartford, CT. Water Resources Div.
M. A. Cervione, B. S. Davies, J. R. Bohr, and B. W. Hunter.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-202630. Price codes: A12 in paper copy, A02 in microfiche.

USGS Water-Data Report CT-90-1. (USGS/WRD/HD-91/242), 1991. 265p. Prepared in cooperation with the State of Connecticut and with other agencies.

Descriptors: *Connecticut, *Data collections, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Connecticut consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels of groundwater wells. Specifically, it contains: (1) discharge records for 43 streamflow-gaging stations, and for 1 tidal volume streamflow station; (2) stage-only records for 3 tidal-gaging stations; (3) content records for 35 lakes and reservoirs; (4) water quality records for 12 streamflow-gaging stations, for 24 ungaged stream sites, for 1 tidal-gaging station, for 4 lakes and reservoirs, for 2 harbors, and for 5 precipitation stations; and (5) water level records for 38 observation wells. Locations of these sites are shown. Additional water data were collected at various sites involved in the systematic data collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Connecticut. (USGS)
W91-11886

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990. VOLUME 2A. SOUTH FLORIDA - SURFACE WATER.
Geological Survey, Miami, FL. Water Resources Div.
W. J. Haire, and C. Price.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-208637. Price codes: A10 in paper copy, A02 in microfiche. USGS Water-Data Report FL-90-2A. (USGS/WRD/HD-91/257), 1991. 203p. Prepared in cooperation with the State of Florida and other agencies.

Descriptors: *Data collections, *Florida, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year in Florida consist of continuous or daily discharge for 349 streams, periodic discharge for 40 streams, miscellaneous discharge for 75 streams, continuous or daily stage for 105 streams, periodic stage for 25 streams, peak discharge for 41 streams, continuous daily tide stage for 12 streams, and peak stage for 40 streams, continuous or daily elevations for 70 lakes, periodic elevations for 70 lakes; continuous groundwater levels for 441 wells, periodic groundwater levels for 1,229 wells, and miscellaneous water level measurements for 1,908 wells; quality of water data for 145 surface water sites and 799 wells. The data for South Florida included continuous or daily discharge for 75 streams, continuous or daily stage for 84 streams, continuous elevation for 2 lakes; continuous groundwater levels for 184 wells, periodic groundwater levels for 873 wells, and miscellaneous water level measurements for 317 wells; quality of water for 15 surface water sites and 541 wells. This data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, state and federal agencies in Florida. (See also W91-02625) (USGS)
W91-11887

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990, VOLUME 2B. SOUTH FLORIDA - GROUND WATER.
Geological Survey, Miami, FL. Water Resources Div.
W. J. Haire, and A. C. Price.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-204602. Price codes: A19 in paper copy, A03 in microfiche. USGS Water-Data Report FL-90-2B. (USGS/WRD/HD-91/238), 1991. 427. Prepared in cooperation with the State of Florida and other agencies.

Descriptors: *Data collections, *Florida, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Florida consist of continuous or daily discharge for 349 streams, periodic discharge for 40 streams, miscellaneous discharge for 75 streams, continuous or daily stage for 105 streams, periodic stage for 25 streams, peak discharge for 41 streams, continuous daily tide stage for 12 streams, and peak stage for 40 streams, continuous or daily elevations for 70 lakes, periodic elevations for 70 lakes; continuous groundwater levels for 441 wells, periodic groundwater levels for 1,229 wells, and miscellaneous water level measurements for 1,908 wells; quality of water data for 145 surface water sites and 799 wells. The data for South Florida include continuous or daily discharge for 75 streams, continuous or daily stage for 84 streams, continuous elevation for 1 lake; continuous groundwater levels for 184 wells, periodic groundwater levels for 873 wells, and miscellaneous water level measurements for 317 wells; quality of water for 15 surface water sites and 541 wells. This data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating with local, state and federal agencies in Florida. (See also W91-02626) (USGS)
W91-11888

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990. VOLUME 4. NORTHWEST FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.
P. E. Meadows, J. B. Martin, and P. R. Mixson.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-204602. Price codes: A19 in paper copy, A03 in microfiche. USGS Water-Data Report FL-90-4. (USGS/WRD/HD-91/281), 1991. 210. Prepared in cooperation with the State of Florida and other agencies.

Descriptors: *Data collections, *Florida, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Florida consist of continuous or daily discharge for 349 streams, periodic discharge for 40 streams, miscellaneous discharge for 75 streams, continuous or daily stage for 105 streams, periodic stage for 25 streams, peak discharge for 41 streams, continuous daily tide stage for 12 streams, and peak stage for 40 streams, continuous or daily elevations for 70 lakes, periodic elevations for 70 lakes; continuous groundwater levels for 441 wells, periodic groundwater levels for 1,229 wells, and miscellaneous water level measurements for 1,908 wells; quality of water data for 145 surface water sites and 799 wells. The data for northwest Florida include continuous or daily discharge for 50 streams, periodic discharge for 0 streams, miscellaneous discharge for 53 streams, continuous or daily stage for 11 streams, peak discharge and stage for 7 streams, continuous or daily elevations for 6 lakes, and periodic elevations for 3 lakes; continuous groundwater levels for 0 wells, and periodic groundwater levels for 20 wells, and miscellaneous water level measurements for 140 wells; quality of water for 14 surface water sites and 0 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida. (USGS)
W91-11889

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1990, VOLUME 1. ILLINOIS EXCEPT ILLINOIS RIVER BASIN.
Geological Survey, Urbana, IL. Water Resources Div.
J. C. Maurer, J. M. Sterling, T. E. Richards, and P. D. Hayes.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-208090. Price codes: A18 in paper copy, A03 in microfiche. USGS Water-Data Report IL-90-1. (USGS/WRD/HD-91/260), 1991. 395p. Prepared in cooperation with the State of Illinois and other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Illinois, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water level and water quality of groundwater wells. This volume contains (1) discharge for 74 streamflow-gaging stations and for 10 crest-stage partial record streamflow stations; (2) stage for 7 streamflow gaging stations; (3) stage and content for 3 lakes and reservoirs; (4) water quality records for 45 streamflow-gaging stations, 3 of which include sediment discharge, and for 31 ungaged stream sites; and (5) water quality records for 20 wells. These data together with the data in Volume 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W91-11890

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1990, VOLUME 2. ILLINOIS RIVER BASIN.
Geological Survey, Urbana, IL. Water Resources Div.
T. E. Richards, P. D. Hayes, and D. J. Sullivan.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-210971. Price codes: A23 in paper copy, A03 in microfiche. USGS Water-Data Report IL-90-2. (USGS/WRD/HD-91/261), 1991. 530p. Prepared in cooperation with the State of Illinois and other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Illinois, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water level and water quality of groundwater wells. This volume contains (1) discharge for 87 streamflow-gaging stations and for 13 crest-stage partial record streamflow stations; (2) stage for 5 streamflow gaging stations and for 3 lake stations; (3) water quality records for 48 streamflow-gaging stations, 1 of which includes sediment discharge, and for 32 ungaged stream sites; (4) water level records for 8 observation wells; and (5) water quality records for 20 wells. These data together with the data in Volume 1 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W91-11891

WATER RESOURCES DATA FOR IOWA, WATER YEAR 1990.
Geological Survey, Iowa City, IA. Water Resources Div.
D. J. O'Connell, M. J. Liszewski, R. B. Lambert, and W. J. Matthes.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-202648. Price codes: A19 in paper copy, A03 in microfiche. USGS Water-Data Report IA-90-1. (USGS/

WRD/HD-91/267), 1990. 421p. Prepared in cooperation with the Iowa Department of Natural Resources (Geological Survey Bureau) and other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Iowa, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Iowa consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; groundwater levels and water quality of groundwater wells. This report contains records of water discharge for 117 stream-gaging stations; stage or contents for 9 lakes and reservoirs; water quality for 6 stream-gaging stations; sediment records for 10 stream-gaging stations; water levels for 185 observation wells; and chemical analyses for the 248 municipal wells. Also included are 120 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous discharge measurements and miscellaneous water quality analyses. (See also W91-01856) (USGS)
W91-11892

WATER RESOURCES DATA FOR KENTUCKY, WATER YEAR 1990.
Geological Survey, Louisville, KY. Water Resources Div.
D. L. McClain, F. D. Byrd, and A. C. Brown.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-202622. Price codes: A19 in paper copy, A03 in microfiche. USGS Water-Data Report KY-90-1. (USGS/WRD/HD-91/241), 1991. 425p. Prepared in cooperation with the State of Kentucky and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Kentucky, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Kentucky consist of records of stage, discharge, and water quality of streams; stage and water levels of wells. This report contains discharge records for 110 gaging stations; suspended-sediment data for 18 stations (8 daily); daily temperature records for 11 stations; daily specific conductance for 10 stations; groundwater levels for 23 continuous-record wells and 117 partial-record wells; water quality data from 42 surface water stations sampled at regular intervals; and miscellaneous temperature and specific conductance data from 69 gaging stations. Also included are 24 partial-record crest-stage and 1 precipitation site. Data collected at various miscellaneous sites are also published. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kentucky. (USGS)
W91-11893

WATER RESOURCES DATA FOR MARYLAND AND DELAWARE, WATER YEAR 1990. VOLUME 1. ATLANTIC SLOPE BASINS, DELAWARE RIVER THROUGH PATUXENT RIVER.
Geological Survey, Towson, MD. Water Resources Div.
R. W. James, R. H. Simmons, B. F. Strain, and M. J. Smigaj.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-200600. Price codes: A22 in paper copy, A03 in microfiche. USGS Water-Data Report MD-DE-90-1. (USGS/WRD/HD-91/251), 1990. 505p. Prepared in cooperation with the states of Maryland and Delaware and with other agencies.

Descriptors: *Data collections, *Delaware, *District of Columbia, *Groundwater, *Hydrologic data, *Maryland, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Maryland and Delaware consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of groundwater wells. This volume contain records for water discharge at 48 gaging stations; water quality at 9 gaging stations and 241 wells; and water levels at 224 observation wells. Also included are data for 1 crest-stage, 17 low-flow, and 6 tidal crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local and Federal agencies in Maryland and Delaware. (USGS)
W91-11894

WATER RESOURCES DATA FOR MARYLAND AND DELAWARE, WATER YEAR 1990, VOLUME 2. MONONGAHELA AND POTOMAC RIVER BASINS.
Geological Survey, Towson, MD. Water Resources Div.
R. W. James, R. H. Simmons, B. F. Strain, and M. J. Smigaj.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-194092. Price codes: A12 in paper copy, A02 in microfiche. USGS Water-Data Report MD-DE-90-2. (USGS/WRD/HD-91/252), 1990. 264p. Prepared in cooperation with the states of Maryland and Delaware and with other agencies.

Descriptors: *Data collections, *Delaware, *District of Columbia, *Groundwater, *Hydrologic data, *Maryland, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Maryland and Delaware consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of groundwater wells. This volume contain records for water discharge at 44 gaging stations; stage and contents at 1 reservoir; water quality at 11 gaging stations and 40 wells; and water levels at 85 observation wells. Also included are data for 3 crest-stage, partial-record stations. Additional water data were collected at various sites not involved in the systematic data collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local and Federal agencies in Maryland and Delaware. (USGS)
W91-11895

WATER RESOURCES DATA FOR MICHIGAN, WATER YEAR 1990.
Geological Survey, Lansing, MI. Water Resources Div.
S. P. Blumer, W. W. Larson, R. J. Minnerick, C. R. Whited, and R. L. LeuVoy.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-200899. Price codes: A13 in paper copy, A02 in microfiche. USGS Water-Data Report MI-90-1. (USGS/WRD/HD-91/249), 1991. 281p. Prepared in cooperation with the State of Michigan and other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Michigan, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Michigan consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water temperature of groundwater. This report contains discharge records for 146 streamflow-gaging stations; stage only records for 1 river-gaging station and 13 lake-gaging stations; stage and contents for 5 lakes and reservoirs; water quality records for 22 streamflow-gaging stations; water level records for 51 observation wells; and water temperature records for 5 observation wells. Also included are 46 crest-stage partial-record stations and 8 low-flow partial record stations. Additional water data were collected at various sites not involved in the systematic data collection program. Miscellaneous data were collected at 63 measuring sites and 22 water quality sampling sites. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State, local and Federal agencies in Michigan. (See also W91-01864) (USGS)
W91-11896

WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1990.
Geological Survey, Helena, MT. Water Resources Div.
R. R. Shields, J. R. Knapton, M. K. White, T. M. Brosten, and T. E. Reed.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-208116. Price codes: A24 in paper copy, A03 in microfiche. USGS Water-Data Report MT-90-1. (USGS/WRD/HD-91/240), 1991. 540p. Prepared in cooperation with the State of Montana and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Montana, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 241 gaging stations; stage/contents for 9 lakes and reservoirs; water quality for 101 stations, 3 lake stations; water levels for 277 observation wells and 10 long-term observation wells equipped with continuous recorders. Also included are 53 smaller reservoirs. Additional water year 1990 data were collected at crest-stage gage and miscellaneous measurement sites but are not published in this report. These data stored within the district office files in Helena are available on request. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. (See also W91-02631) (USGS)
W91-11897

WATER RESOURCES DATA FOR NEBRASKA, WATER YEAR 1990.
Geological Survey, Lincoln, NE. Water Resources Div.
J. A. Boohar, C. G. Hoy, and G. V. Steele.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-193623. Price codes: A15 in paper copy, A02 in microfiche. USGS Water-Data Report NE-90-1. (USGS/WRD/HD-91/270), 1991. 325p. Prepared in cooperation with the State of Nebraska and other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Nebraska, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Nebraska consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality in wells. This report contains discharge records for 161 streamflow gaging stations, 8 partial-record or miscellaneous streamflow stations,

and 2 crest stage, partial-record streamflow stations; stage and contents records for 11 lakes and reservoirs; water quality records for 19 streamflow stations, 7 ungaged stream-sites, and 82 wells; and water level records for 55 observation wells. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Nebraska. (See also W91-01829) (USGS)
W91-11898

WATER RESOURCES DATA FOR NEW MEXICO, WATER YEAR 1990.
Geological Survey, Albuquerque, NM. Water Resources Div.
J. P. Borland, R. R. Cruz, R. L. McCracken, R. L. Lepp, and D. Ortiz.
Available from National Technical Information Service, Springfield, VA 22161 as PB-205658. Price codes: A21 in paper copy, A03 in microfiche. USGS Water-Data Report NM-90-1. (USGS/WRD/HD-91/282), 1991. 466p. Prepared in cooperation with the State of New Mexico and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *New Mexico, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for New Mexico consist of records of discharge and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 167 gaging stations; stage and contents for 26 lakes and reservoirs; water quality for 59 gaging stations and 168 wells; and water levels at 114 observation wells. Also included are 109 crest-stage partial-record stations. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. Also, 3 seepage investigations are published this year. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in New Mexico. (USGS)
W91-11899

WATER RESOURCES DATA FOR NORTH CAROLINA, WATER YEAR 1990.
Geological Survey, Raleigh, NC. Water Resources Div.
B. C. Ragland, R. G. Barker, W. H. Eddins, and J. F. Rinehardt.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-197889. Price codes: A18 in paper copy, A03 in microfiche. USGS Water-Data Report NC-90-1. (USGS/WRD/HD-91/253), 1991. 389p. Prepared in cooperation with the State of North Carolina and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *North Carolina, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for North Carolina consists of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and groundwater levels. This report contains discharge records for 167 gaging stations and stage and contents for 26 lakes and reservoirs; water quality for 30 gaging stations and 3 miscellaneous sites; continuous daily tide stage for 10 sites; and water levels for 46 observation wells. Additional water data were collected at various sites not involved in the systematic data collection program, and are published as miscellaneous measurements in this report. The collection of water resources data in North Carolina is part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, municipal, and Federal agencies. (USGS)
W91-11900

WATER RESOURCES DATA FOR OHIO, WATER YEAR 1990. VOLUME 1. OHIO RIVER BASIN.
Geological Survey, Columbus, OH. Water Resources Div.
H. L. Shindel, J. H. Klingler, J. P. Mangus, and L. E. Trimble.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-197103. Price codes: A14 in paper copy, A02 in microfiche. USGS Water-Data Report OH-90-1. (USGS/WRD/HD-91/245), 1991. 305p. Prepared in cooperation with the State of Ohio and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Ohio, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of groundwater wells. This report, in two volumes, contains records for water discharge at 131 gaging stations, 67 wells, and 39 partial-record sites; and water levels at 229 observation wells. Also included are data from miscellaneous sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Ohio. (See also W90-06489) (USGS)
W91-11901

WATER RESOURCES DATA FOR OHIO, WATER YEAR 1990. VOLUME 2. ST. LAWRENCE RIVER BASIN.
Geological Survey, Columbus, OH. Water Resources Div.
H. L. Shindel, J. H. Klingler, J. P. Mangus, and L. E. Trimble.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-197111. Price codes: A13 in paper copy, A02 in microfiche. USGS Water-Data Report OH-90-2. (USGS/WRD/HD-91/246), 1991. 281p. Prepared in cooperation with the State of Ohio and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Ohio, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of groundwater wells. This report, in two volumes, contains records for water discharge at 131 gaging stations, 67 wells, and 39 partial-record sites; and water levels at 229 observation wells. Also included are data from miscellaneous sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Ohio. (See also W90-06490) (USGS)
W91-11902

WATER RESOURCES DATA FOR OKLAHOMA, WATER YEAR 1989.
Geological Survey, Oklahoma City, OK. Water Resources Div.
R. L. Blazs, D. M. Walters, T. E. Coffey, D. K. White, and D. L. Boyle.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-201079. Price codes: A23 in paper copy, A03 in microfiche. USGS Water-Data Report OK-89-1. (USGS/WRD/HD-91/235), 1990. 522p. Prepared in cooperation with the State of Oklahoma and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Oklahoma, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Oklahoma consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs. This report contains discharge records for 133 gaging stations; stage and contents for 30 lakes and reservoirs; water quality for 46 gaging stations and 2 lakes. Also included are 7 partial-record stations. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Oklahoma. (See also W91-04868) (USGS)
W91-11903

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1990, VOLUME 2. WESTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
L. E. Hubbard, T. A. Herrett, R. L. Kraus, and C. G. Kroll.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-204594. Price codes: A16 in paper copy, A02 in microfiche. USGS Water-Data Report OR-90-2. (USGS/WRD/HD-91/250), 1991. 336p. Prepared in cooperation with the State of Oregon and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Oregon, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Oregon consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs. This report, in two volumes, contains discharge records for 246 gaging stations; stage only records for 10 gaging stations; stage and contents for 37 lakes and reservoirs; water quality for 47 stations, and water quality for 3 precipitation stations. Also included are 5 crest-stage, partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (USGS)
W91-11904

WATER RESOURCES DATA FOR VIRGINIA, WATER YEAR 1990. VOLUME 1. SURFACE WATER AND SURFACE-WATER-QUALITY RECORDS.
Geological Survey, Richmond, VA. Water Resources Div.
B. J. Prugh, F. J. Easton, and D. L. Belval.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-200741. Price codes: A18 in paper copy, A03 in microfiche. USGS Water-Data Report VA-90-1. (USGS/WRD/HD-91/248), 1991. 407p. Prepared in cooperation with the State of Virginia and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Surface water, *Virginia, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Virginia includes records of stage, discharge, and water quality of streams; and stage contents, and water quality of lakes and reservoirs. This volume contains records for water discharge at 171 gaging stations; stage only at 1 gaging station; stage and contents at 10 lakes and reservoirs; and water quality at 51 gaging stations. Also included are data for 100 crest stage partial-record stations. Locations of these sites are shown. Miscellaneous hydrologic data were collected at 70 measuring sites and 25 water quality sampling sites not involved in the systematic data collection program. The data in this report represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Virginia. (USGS)
W91-11905

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1990.
Geological Survey, Charleston, WV. Water Resources Div.
S. M. Ward, W. A. Hobba, F. M. Taylor, and M. C. Waldron.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-193714. Price codes: A09 in paper copy, A01 in microfiche. USGS Water-Data Report WV-90-1. (USGS/WRD/HD-91/255), 1991. 181p. Prepared in cooperation with the State of West Virginia and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Surface water, *Water quality, *West Virginia, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for West Virginia consist of records of stage, discharge, and water quality of streams; contents of reservoirs; and water levels of observation wells. This report contains discharge records for 81 streamflow-gaging stations; stage only records for 7 gaging stations; annual maximum discharge at crest-stage partial-record stations; change in contents for 1 reservoir; water quality records for 13 streamflow-gaging stations; and water level records for 30 observation wells. Locations of these sites are shown. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in West Virginia. (USGS)
W91-11906

WATER RESOURCES DATA FOR WYOMING, WATER YEAR 1990.
Geological Survey, Cheyenne, WY. Water Resources Div.
S. A. Druse, W. R. Glass, D. A. Peterson, and M. L. Smalley.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-190942. Price codes: A22 in paper copy, A03 in microfiche. USGS Water-Data Report WY-90-1. (USGS/WRD/HD-91/254), 1991. 494p. Prepared in cooperation with the State of Wyoming and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Surface water, *Water quality, *Wyoming, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sediments, Water analysis, Water sampling, Water temperature.

Water resources data for the 1990 water year for Wyoming consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of groundwater. This report contains discharge records for 198 gaging stations; stage and contents for 16 lakes and reservoirs; water quality for 62 gaging stations, and 55 ungaged stations; and water levels for 5 observation wells. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Wyoming. (See also W90-06553) (USGS)
W91-11907

COMPUTER SOFTWARE FOR CONVERTING GROUND-WATER AND WATER-QUALITY DATA FROM THE NATIONAL WATER INFORMATION SYSTEM FOR USE IN A GEOGRAPHIC INFORMATION SYSTEM.
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. C. Scott.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 90-4200, 1990. 55p, 5 fig, 8 tab, 21 ref.

Descriptors: *Data processing, *Data storage and retrieval, *Geographic information systems, Computer programs, Groundwater, Statistical analysis, Water quality.

A geographic information system (GIS) is computer software that provides capabilities to display and analyze spatially referenced data. To use a GIS efficiently, software is needed that provides a link between existing spatially referenced database systems and the GIS. The U.S. Geological Survey (USGS) stores large amounts of spatially referenced hydrologic data in computerized database systems. Currently, these database systems are physically located on minicomputers that are installed in many USGS offices nationwide. This report describes software that can be used quickly and easily to convert site description and water quality data from these database systems to the GIS that is used by the USGS. The software described in this report is designed to be used with the same hardware and software that is available to most USGS personnel. (USGS)
W91-11923

WATER RESOURCES ACTIVITIES IN FLORIDA, 1990-91.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-11928

SUMMARY AND ANALYSIS OF WATER-USE DATA COLLECTION IN EASTERN ARKANSAS.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 6D.
W91-11937

LOCATIONS MAPS AND LIST OF U.S. GEOLOGICAL SURVEY REPORTS ON WATER RESOURCES IN ALASKA, 1950 TO 1990.
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 10C.
W91-11942

GEOHYDROLOGY AND GROUND-WATER FLOW SIMULATION OF THE SURPRISE SPRING BASIN AQUIFER SYSTEM, SAN BERNARDINO COUNTY, CALIFORNIA.
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W91-11945

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE SUWANNEE RIVER WATER MANAGEMENT DISTRICT.
Geological Survey, Tallahassee, FL. Water Resources Div.
P. E. Meadows.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-582, 1991. 1 sheet, 1 fig.

Descriptors: *Florida, *Groundwater level, *Potentiometric level, *Upper Floridan Aquifer, Suwannee River Water Management District.

The May 1990 potentiometric-surface map of the Upper Floridan aquifer in the Suwannee River Management District Area of Florida depicts groundwater levels for the annual low water-level period. Water levels in wells measured were lower in May 1990 than in May 1985. The May 1990 levels were 1 to 5 ft lower than those measured in May 1985 with the greatest declines occurring in the eastern part of the study area. The water level declines were due in part to below normal rainfall, during 1989 and the first part of 1990. (USGS)
W91-11951

THEORETICAL DETERMINATION OF THE CHARACTERISTIC EQUATION OF SNOW IN THE PENDULAR REGIME.
British Antarctic Survey, Cambridge (England).
E. M. Morris, and R. J. Kelly.
Journal of Glaciology JOGLAO, Vol. 36, No. 123, p 179-187, 1990. 6 fig, 1 tab, 18 ref, 2 append.

Descriptors: *Ice, *Mathematical models, *Model studies, *Pendular water, *Snow, *Snowpack, *Theoretical analysis, Air-water interfaces, Density, Experimental data, Interstitial water, Saturation.

Recent mathematical models treat a natural snowpack as a mixture body consisting of solid ice grains, liquid water, and a gas made up of air and water vapor. Such a model requires two independent constitutive equations for the two independent volume fractions. However, so far only one equation, a power law relating the liquid-water content to capillary pressure, has been suggested, by analogy, with the so-called 'characteristic' equation for liquid water in soils. Experimental data from drainage tests on snow columns may be used to determine the characteristic equation for snow with relatively high water contents. However, this experimental method is not valid when water exists in isolated inclusions in the snow, i.e. in the pendular regime. A theoretical method is used to derive two independent volume-fraction laws for snow in the pendular regime. However, calculations made using this method cannot be expected to give correct results concerning the gross response. (Author's abstract)
W91-11982

MODELING THE INFLUENCE OF SORPTION AND TRANSFORMATION ON PESTICIDE LEACHING AND PERSISTENCE.
Winand Staring Centre for Integrated Land, Soil and Water Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 5B.
W91-12003

APPLICATION OF ENTROPY CONCEPT IN OPEN-CHANNEL FLOW STUDY.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W91-12054

STOCHASTIC STUDY OF FLOODS IN CANADA: TRUNCATION LEVEL BY REGION.
Department of Fisheries and Oceans, Moncton (New Brunswick). Science Branch.
For primary bibliographic entry see Field 2E.
W91-12089

NETWORK FLOW MODELING OF OROVILLE COMPLEX.
Snowy Mountains Engineering Corp., Cooma (Australia).
For primary bibliographic entry see Field 4A.
W91-12203

RECURRENCE INTERVAL OF GEOPHYSICAL EVENTS.

California Univ., Santa Barbara. Dept. of Geography.
H. A. Loaiciga, and M. A. Marino.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 117, No. 3, p 367-382, May/June 1991. 3 fig, 1 tab, 16 ref, 6 append.
California Department of Water Resources Grant B-57105 and Agricultural Research Service Cooperative Agreement 4116-H.

Descriptors: *Decision making, *Geophysics, *Natural hazards, *Recurrence interval, *Risk assessment, *Statistics, Climates, Geology, Prediction.

The recurrence interval is the expected length of time intervening between consecutive geophysical events. Using probabilistic reasoning, the relationship between the recurrence interval and the distribution of geophysical events, the concept of risk, the memoryless property of the distribution of the time to the next episode, and the behavior of the 'excess' time to the next event were examined. Also examined was the contrast between the necessary statistical conditions required for the mathematical analysis of these variables and the geoclimatic changes inherent in natural processes that tend to limit the value of classical analysis of the recurrence of extreme geophysical phenomena and their associated risks. Annual and partial duration series were considered. The assessment of risk and the consideration of hazard potential in a large number of critical structures, such as flood control dams and nuclear power plants, customarily is based on classical, yet geologically inadmissible, statistical assumptions. The present analysis stresses the importance of assessing natural hazard potential by a better scientific understanding of past and present geologic and climatic processes and their influence of future events. The dilemma of determining the risk involved in building certain infrastructure, which is brought about by the limitations of conventional tools of statistical analysis, points to the need to employ a broader context of references including ethical, political, and economic values that would help reach socially acceptable decisions involving 'risk.' (Rochester-PTT)
W91-12207

CHARLOTTE MAPS NEW WASTEWATER STRATEGIES WITH GIS.
Camp, Dresser and McKee, Inc., Raleigh, NC.
For primary bibliographic entry see Field 5D.
W91-12211

INFORMATION TRANSFER WITH CENSORED DATA: SOME LARGE-SAMPLE RESULTS.
Instituto de Pesquisas Hidraulicas, Porto Alegre (Brazil).
For primary bibliographic entry see Field 2E.
W91-12217

NUMERICAL MODELING OF NATURAL AND ENHANCED DENITRIFICATION PROCESSES IN AQUIFERS.
Gesamthochschule Kassel (Germany, F.R.). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W91-12228

RATE-LIMITED SORPTION AND NONEQUILIBRIUM TRANSPORT OF ORGANIC CHEMICALS IN LOW ORGANIC CARBON AQUIFER MATERIALS.
Arizona Univ., Tucson. Dept. of Soil and Water Science.
For primary bibliographic entry see Field 5B.
W91-12229

NUMERICAL EVALUATION OF ITERATIVE AND NONITERATIVE METHODS FOR THE SOLUTION OF THE NONLINEAR RICHARDS EQUATION.
Princeton Univ., NJ. Water Resources Program.
For primary bibliographic entry see Field 2G.
W91-12230

APPROXIMATING CATASTROPHIC RISK THROUGH STATISTICS OF EXTREMES.
Analytic Sciences Corp., Reading, MA. Strategic Systems Div.
For primary bibliographic entry see Field 6A.
W91-12236

FRACTAL STRUCTURES OF RIVER PLAN FORMS.
Akademiya Nauk Moldavskoi SSR, Kishinev. Inst. of Geophysics and Geology.
For primary bibliographic entry see Field 2E.
W91-12246

ANALYSES OF INFILTRATION EVENTS IN RELATION TO DETERMINING SOIL HYDRAULIC PROPERTIES BY INVERSE PROBLEM METHODOLOGY.
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
For primary bibliographic entry see Field 2G.
W91-12249

STOCHASTIC DISTRIBUTED MODEL OF SOIL EROSION BY OVERLAND FLOW.
Silsoe Coll. (England).
For primary bibliographic entry see Field 2J.
W91-12262

EVALUATION OF RAINDROP SPECTRA. PART I: SOLUTION TO THE STOCHASTIC COLLECTION/BREAKUP EQUATION USING THE METHOD OF MOMENTS.
Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
G. Feingold, S. Tzivion, and Z. Levin.
Journal of the Atmospheric Sciences JAHSAK, Vol. 45, No. 22, p 3387-3399, November 15, 1988. 6 fig, 19 ref, 2 append.

Descriptors: *Data interpretation, *Mathematical analysis, *Meteorology, *Rain, *Raindrops, *Statistics, *Stochastic models, Breakup, Distribution, Mass transfer, Mathematical equations, Precipitation.

The stochastic collection/breakup equation (SCE/SBE) was analyzed using a recently developed method of moments and the Low and List fragment distribution function, proving that the collisional breakup equation conserves overall mass irrespective of the degree to which the fragment distribution function conserves mass for individual collisions. The method is compared with analytical solutions to the steady state collection/breakup equation, as well as with the breakup equation, for simple kernels. The proposed method produces better approximations to the analytical solutions for simple kernels, than those obtained using a single moment method. In writing the breakup terms, an approximation to the breakup kernel and fragment distribution function in discrete categories was used. This approach allows one to write the algorithm without prescribing the shape of the distribution function within the category. The approximation to the fragment distribution function in a discrete category was validated using existing single moment methods. In cases of breakup dominated evolution, one and two-moment solutions to the collection/breakup equation were shown to differ little, though the solutions to collection dominated evolution are expected to differ appreciably. The method of moments thus represents a more universal, accurate approach to solving mass transfer equations. (See also W90-04597) (Author's abstract)
W91-12304

FURTHER DEVELOPMENTS OF THE NEYMAN-SCOTT CLUSTERED POINT PROCESS FOR MODELING RAINFALL.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W91-12320

STOCHASTIC MODEL OF INFILTRATION WHICH SIMULATES 'MACROPORE' SOIL WATER FLOW.
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
For primary bibliographic entry see Field 2G.
W91-12321

MEANING OF RANDOMNESS IN STOCHASTIC ENVIRONMENTAL MODELS.
Ontario Hydro, Toronto. Research Div.
P. A. Zielinski.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1607-1611, July 1991. 3 fig, 3 tab, 23 ref.

Descriptors: *Data interpretation, *Mathematical models, *Model studies, *Randomness, *Statistics, *Stochastic hydrology, Comparison studies, Differential equations, Mathematical analysis, Mathematical equations, Monte Carlo method.

In the past decade, many mathematical environmental models with random or stochastic components have been developed. The most widely used stochastic technique, the Monte Carlo simulation, has always been popular, mainly due to its simplicity, but also because it matches 'the intuition of randomness.' The limitations of the approach itself have been always related to the computational time requirements only. Recent progress in applied stochastic process theory has provided modelers with the ability to solve analytically some of the equations containing stochastic components in the environmental modeling area. As a result, a number of models based on stochastic differential equation (SDE) theory have been developed. However, simultaneous use of SDE and Monte Carlo models can present the model user with unexpected and confusing discrepancies in model solutions. It is shown in this paper that both of the approaches may be valid, depending on the assumptions made, and depending on the nature of the randomness involved, two different classes of models (both with the same representing equations) can be developed. These models are: (1) random variable (RV) models which are based on the concept that uncertainty concerns can be addressed by assuming that the coefficients of the model are random variables, and stochastic processes (SP) models which treat the coefficients of the models as stochastic processes. The way in which randomness is represented in the model equations has a significant impact on the stochastic characteristics of the solution process. Depending on the magnitude of parameters, inputs and time intervals involved the differences in the moment estimates of the solution process can be in the range of hundreds of percent. Any comparisons between the results obtained through these two distinct groups of models are meaningless since groups represent entirely different concepts of randomness in environmental modeling. The SDE approach should be chosen if one analyzes, for example, the rate of coefficient in the BOD equation. If k is a random variable, its value is randomly selected but once that is done, it remains constant along the river reach corresponding to the selected time interval. On the other hand, if stochastic process interpretation is assumed, k is able to vary randomly about its mean as a function of travel time along the reach. (Lantz-PTT)
W91-12335

SHORT-TERM FLOOD RISK PREDICTION: A COMPARISON OF THE COX REGRESSION MODEL AND A CONDITIONAL DISTRIBUTION MODEL.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-12339

FLOW THROUGH FISSURED POROUS MEDIA WITH DEFORMABLE MATRIX: IMPLICIT FORMULATION.
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-12345

SIMULATION OF NON-GAUSSIAN SPACE RANDOM FUNCTIONS FOR MODELING TRANSPORT IN GROUNDWATER.
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W91-12346

GOODNESS-OF-FIT TESTS FOR REGIONAL GENERALIZED EXTREME VALUE FLOOD DISTRIBUTIONS.
Institute of Flood Control and Drainage Research, Dacca (Bangladesh).
For primary bibliographic entry see Field 2E.
W91-12350

SEDIMENT DISCHARGE COMPUTATION USING POINT-SAMPLED SUSPENDED-SEDIMENT DATA.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2J.
W91-12360

SHALLOW WATER FLOW WITH CYLINDRICAL SYMMETRY.
Reading Univ. (England). Dept. of Mathematics.
For primary bibliographic entry see Field 8B.
W91-12369

NUMERICAL MODELLING OF FREE SURFACE FLOWS: STATE OF THE ART AT THE LABORATOIRE NATIONAL D'HYDRAULIQUE, EDF, CHATOU (MODELISATION NUMERIQUE DES ECOULEMENTS A SURFACE LIBRE: L'ETAT DE L'ART AU LABORATOIRE NATIONAL D'HYDRAULIQUE (LNH) DE L'EDF A CHATOU).
For primary bibliographic entry see Field 2E.
W91-12412

ANALYTICAL METHOD TO DETERMINE HENRY'S LAW CONSTANT FOR SELECTED VOLATILE ORGANIC COMPOUNDS AT CONCENTRATIONS AND TEMPERATURES CORRESPONDING TO TAP WATER USE.
Harvard School of Public Health, Boston, MA. Dept. of Environmental Health Sciences.
For primary bibliographic entry see Field 5B.
W91-12452

HYDROLOGIC REGRESSION SEDIMENT-YIELD MODEL FOR TWO UNGAGED WATERSHED OUTLET STATIONS IN AFRICA.
Military Technical Coll., Cairo (Egypt).
For primary bibliographic entry see Field 2J.
W91-12462

GROUNDWATER QUALITY MODEL WITH APPLICATIONS TO VARIOUS AQUIFERS.
Ain Shams Univ., Cairo (Egypt). Dept. of Irrigation and Hydrology.
For primary bibliographic entry see Field 5B.
W91-12465

RECENT PROGRESS IN SNOW AND ICE RESEARCH.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2C.
W91-12507

MESO-BETA-SCALE POTENTIAL VORTICITY ANOMALIES AND RAINBANDS. PART I: ADIABATIC DYNAMICS OF POTENTIAL VORTICITY ANOMALIES.
Toronto Univ. (Ontario). Dept. of Physics.
For primary bibliographic entry see Field 2B.
W91-12532

ESTIMATING CLOUD WATER DEPOSITION TO SUBALPINE SPRUCE-FIR FORESTS: II. MODEL TESTING.
Tennessee Valley Authority, Muscle Shoals, AL.
For primary bibliographic entry see Field 2B.
W91-12544

WATERMATEX '91.
For primary bibliographic entry see Field 6A.
W91-12568

PRINCIPLES OF MODELLING.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. B. Beck.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 1-8, 1991. 26 ref.

Descriptors: *Data interpretation, *Mathematical models, *Model studies, *Model testing, Calibrations, Decision making, Error analysis, Estimating, Experimental design, Model verification, Parameter estimation, Pollutants, Prediction, Prediction error propagation, System identification, Uncertainty.

The scope for modeling the behavior of pollutants in the aquatic environment is now immense. The conventional procedure of model development begins with conceptualization, is followed by the specification of an appropriate numerical solution scheme, then by calibration, verification/validation, and finally application of the model to its intended purpose of prediction. There is an increasing need for a set of principles of modeling that, in some respects, may well be different from those applicable when conceptualization, the accuracy of the numerical solution scheme, and the inadequacies of an overly simplified model structure, were the issues of the day. Given the availability of increasingly comprehensive software, the user of a model is increasingly likely to be accelerated into a position where the issue of model calibration (identification) is an immediate problem. It is argued that a consistent approach to establishing whether such identification is necessary depends on establishing the significance, or otherwise, of model uncertainty. Identifying the model against field data does not just yield 'best' estimates of the unknown coefficients (parameters) appearing in the given model structure, but may also serve to identify and modify the uncertainty attached to the model as a description of observed behavior. (See also W91-12568) (Author's abstract)
W91-12569

DESIGNING EXPERIMENTS FOR MODEL IDENTIFICATION OF THE NITRIFICATION PROCESS.
New Hampshire Univ., Durham. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-12570

IDENTIFICATION OF A MECHANISTIC MODEL FOR THE DIURNAL DISSOLVED OXYGEN PATTERN IN LAKES WITH DISCRETE TIME SERIES ANALYSIS.
Agricultural Univ., Wageningen (Netherlands). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2H.
W91-12571

INVESTIGATION OF A NEW APPROACH TO PREDICT WATER QUALITY EXTREMES WITH A CASE STUDY OF CHEMICAL DETERMINANDS IN STREAM WATER.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
For primary bibliographic entry see Field 5B.
W91-12572

OPTIMIZING WATER QUALITY MODELING IN AN UNCERTAIN ENVIRONMENT.
Texas Univ. at Dallas, Richardson. Inst. for Environmental Sciences.
For primary bibliographic entry see Field 5B.
W91-12574

NON-LINEAR STOCHASTIC MODEL FOR ADSORPTION IN BATCH REACTORS.
Kansas State Univ., Manhattan. Dept. of Statistics.
For primary bibliographic entry see Field 5D.
W91-12575

TETRANS: A USER-FRIENDLY, FUNCTIONAL MODEL OF SOLUTE TRANSPORT.
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 5B.
W91-12576

WATER QUALITY MANAGEMENT OF KEELUNG RIVER, NORTHERN TAIWAN.
National Taiwan Univ., Taipei. Inst. of Environmental Engieering.
For primary bibliographic entry see Field 5G.
W91-12581

DEVELOPMENT OF A PERSONAL COMPUTER-BASED SYSTEM TO SUPPORT BASIN-WIDE MANAGEMENT OF WATER QUALITY IN LAKES AND RIVERS.
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Chemical Engineering.
M. Okada, K. Chihara, H. Kawashima, and M. Suzuki.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 125-132, 1991. 9 fig, 4 ref.

Descriptors: *Computer models, *Computer programs, *Data interpretation, *Management planning, *Model studies, *Performance evaluation, *Water pollution control, *Water quality, Decision making, Eutrophication, Management software, Personal computers, Pollution load, Watershed management.

Although various kinds of models for river and lake water quality management have been developed, the application of these models to a specific water body is not always easy because most of them presuppose a basic understanding of model structure and biological, physical, and chemical processes in the water. In addition, pollution loads must be summed up beforehand, taking all the complicated socioeconomic activities into consideration. A personal computer-based, easy access software program has been created to help water authorities develop a basin-wide comprehensive management plan for water quality control. The River Basin Management System (RBMS) was created using the C-language, except for the advisory subsystem where Prolog was used. Users are requested to supply geological and administrative mapping of pollution sources and related socioeconomic information. The system then estimates pollution loads from the basin including both point and non-point sources and predicts the quality of the water bodies (i.e., river systems and lakes), based on the present load and expected loads after alternative management plans are implemented. A small polluted river basin in Japan, Lake Sagami-ko and its tributary, the Katsura River system was used as a model basin for system development and validation. Pollution loads to the river basin of the Katsura River were estimated easily and the simulated water quality in Lake Sagami-ko was in good agreement with observed data. In addition, several countermeasures on water pollution control in the water bodies were assessed by the system to demonstrate the function of recalculation of pollutant loads and subsequent estimation of water quality. (See also W91-12568) (Korn-PTT)
W91-12583

NUTRIENT MODEL FOR A LAKE WITH TIME-VARIABLE VOLUMES.
National Taiwan Univ., Taipei. Dept. of Civil Engineering.
J. T. Kuo, and J. H. Wu.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 133-139, 1991. 6 fig, 6 ref.

Descriptors: *Chen-Chin Lake, *Data interpretation, *Eutrophication, *Limnology, *Model studies, *Nutrients, *Temporal variation, Eutrophic

lakes, Mathematical models, Model testing, Phosphorus, Taiwan, Total phosphorus, Water chemistry.

A total nutrient model for a completely mixed water body is often used for lake eutrophication analysis. In the model, an assumption of the constant volume of a lake is usually made, i.e., the inflow to the lake is equal to the outflow. However, for some lakes which have a significant difference between inflow and outflow during a study period (usually larger than the detention time), the assumption of constant volume is no longer valid and could cause solution errors. Therefore, more general model were developed which solves the nutrient mass balance equation for a lake with time-variable volumes. In the model, the power series method is used to obtain a solution; taking the first few terms in the power series (e.g., fewer than 15 terms), the approximate solution is very close to the exact solution. In this way, both computer time and numerical error can be minimized compared to the numerical solution. This newly developed nutrient model was applied to Chen-Chin Lake in southern Taiwan for phosphorus modeling in a eutrophication study. It was determined that the comparison between model results and measured total P concentrations was favorable--the concentration of total P was much higher than 20 microgram/liter and the lake was under severe eutrophication. (See also W91-12568) (Korn-PTT)
W91-12584

COMPUTER SIMULATIONS OF THE HYDRODYNAMIC AND SALINITY BEHAVIOR OF WEEKS BAY, ALABAMA, AT EQUATORIAL TIDE CONDITIONS.
Alabama Univ., University. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2L.
W91-12588

STOCHASTIC CONTROL OF THE ACTIVATED SLUDGE PROCESS.
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5D.
W91-12598

PICTORIAL SIMULATION APPLIED TO WATER QUALITY MODELING.
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
For primary bibliographic entry see Field 5G.
W91-12601

DELAQUA--A PROTOTYPE EXPERT SYSTEM FOR OPERATIONAL CONTROL AND MANAGEMENT OF LAKE WATER QUALITY.
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 5C.
W91-12602

EXPERT SUPPORT SYSTEM FOR COST MODELING AND EVALUATION OF WASTEWATER TREATMENT.
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5D.
W91-12603

RULE-BASED EXPERT SYSTEMS IN THE CONTROL OF WASTEWATER TREATMENT SYSTEMS.
Soil and Water Ltd., Helsinki (Finland).
For primary bibliographic entry see Field 5D.
W91-12604

ASPECTS OF INTELLIGENT TUTORING SYSTEMS APPLIED TO SMALL WATER TREATMENT PLANT EXPERT SYSTEMS.
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-12605

INTEGRATED MODEL EVALUATION SYSTEM (IMES): A DATABASE FOR EVALUATION OF EXPOSURE ASSESSMENT MODELS.
Versar, Inc., Columbia, MD.
S. P. Schreiner, M. Gaughan, H. L. Schultz, and R. Walentowicz.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 315-322, 1991. 10 fig, 4 ref.

Descriptors: *Computer programs, *Data interpretation, *Databases, *Model studies, *Risk assessment, *Water pollution effects, Computer models, Exposure assessment, Information transfer, Public health, Toxicity.

The United States Environmental Protection Agency (USEPA) Office of Health and Environmental Assessment develops methodologies for conducting exposure and risk assessments. Protocols appropriate for specific analyses have been developed to aid in the selection of an exposure assessment model and to assess the validation and uncertainties associated with a model used for toxic chemical exposure assessments in surface water, groundwater, and air. A software package has been developed to provide users with a quick and intuitive tool to assess information for selected models and applications based on these protocols. This Integrated Model Evaluation System (IMES) is composed of three modules: (1) Selection, query systems for selecting a model based on technical criteria (currently for surface water, non-point source, and groundwater models); (2) Validation, a database containing validation and other information on over 50 models in various media; and (3) Uncertainty, a database demonstrating uncertainty simulations for several surface water models applied to exposure assessments of several chemicals. The selection modules are linked to the uncertainty modules to access information for chosen models. The PC-based software system employs pull-down menus, help screens, and graphics to display its information. (See also W91-12568) (Author's abstract)
W91-12606

COMPUTERIZED BIOLOGICAL TREATMENT OPERATIONAL PROCESS CONTROL.
Stover and Associates, Stillwater, OK.
E. L. Stover, and C. K. Campana.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 323-330, 1991. 2 fig, 1 ref.

Descriptors: *Computer programs, *Data interpretation, *Expert systems, *Process control, *Wastewater facilities, *Wastewater treatment, Artificial intelligence, Computers, Control systems, Data processing, Operating policies, Performance evaluation, Simulation analysis, Statistical analysis.

An integrated data management and operational process control system along with diagnostic and predictive Expert Systems (ES) has been developed to assist in the operation of wastewater treatment plants. The data manager stores and analyzes plant operational data, and generates any reports required for documentation. Bio-kinetic process control equations and analysis provide daily operational strategies based on a moving analysis of plant performance. Statistical analysis of trends for important parameters, and simulation add additional analytical power to the package. The ES can operate in a generic, stand-alone mode, or can be interfaced with the database. The system should be able to diagnose and anticipate many treatment plant problems in early stages, before they become critical, allowing simple and economical corrective measures to be taken. In addition, plant performance can be optimized using the simulation and data analysis capabilities of the package. Finally, the playback and explanation features of the ES will allow the user to examine the logic used in arriving at a particular recommendation or decision. This can be useful in helping the user better understand treatment plant operation and problem diagnosis. The technical concepts and methodology used in this operational process control approach have been developed from actual operations experience over the last 20 years and have been successfully employed at several biological wastewater treatment plants. (See also W91-12568) (Korn-PTT)
W91-12607

DBAPE--A DATABASE AND MODEL PARAMETER ANALYSIS SYSTEM FOR AGRICULTURAL SOILS TO SUPPORT WATER QUALITY MANAGEMENT.
AQUA TERRA Consultants, Decatur, GA.
J. C. Imhoff, R. F. Carsel, J. L. Kittle, and P. R. Hummel.
Water Science and Technology WSTED4, Vol. 24, No. 6, p 331-337, 1991. 2 fig, 11 ref.

Descriptors: *Data interpretation, *Databases, *Model studies, *Soil types, *Water pollution control, *Water quality management, Algorithms, Computer programs, Estimating, Management planning, Meteorological data, Model testing, Pesticides, Soil water.

DBAPE is an interactive computer program that was originally created to encourage and support the use of RUSTIC, a newly developed model that simulates the transport of field-applied pesticides in the crop root zone, the unsaturated zone, and the saturated zone. DBAPE provides an efficient means to obtain soils and meteorologic data from a database that contains information on over 8000 agricultural soils and 160 meteorologic stations located throughout the contiguous United States. In addition to database exploration, DBAPE can also be used to clarify the impact of data on modeled processes, screen geographically based data to identify potential sites for model testing, and develop initial guidance on alternative management strategies. The program allows analysis of the databases, estimation of soil and soil water parameters, display of data in the form of generated reports, production of geographic maps illustrating the results of database searches, and plots of soil water functional relationships. The DBAPE program was developed to run on an IBM-PC with 640 KB of memory and a math coprocessor. (See also W91-12568) (Korn-PTT)
W91-12608

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1990.
Geological Survey, Tuscaloosa, AL. Water Resources Div.
J. L. Pearman, F. C. Sedberry, V. E. Stricklin, and P. W. Cole.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-208108. Price codes: A18 in paper copy, A03 in microfiche. USGS Water-Data Report AL-90-1. (USGS/WRD/HD-91/262), 1991. 407p. Prepared in cooperation with the Alabama Dept. of Environmental Management, Geological Survey of Alabama, the Highway Dept., and with other State, Municipal, and Federal agencies.

Descriptors: *Alabama, *Data collections, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for the 1990 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report includes records of both surface and groundwater in the State. Specifically, it contains: (1) discharge records for 96 streamflow-gaging stations, for 65 partial-record or miscellaneous streamflow stations; (2) stage and content records for 13 lakes and reservoirs and stage at 31 stations; (3) water quality records for 29 streamflow-gaging stations, 9 lake stations, 29 ungaged streamsites, and 1 precipitation station; (4) water temperature at 16 surface-water stations; and (5) water level records for 2 recording observation wells and 61 periodic observation wells. Discharge records for a few pertinent stations in bordering States are also included in this report. (USGS)

W91-12643

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1990. VOLUME 1A: NORTHEAST FLORIDA - SURFACE WATER.
Geological Survey, Altamonte Springs, FL. Water Resources Div.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-208629. Price codes: A20 in paper copy, A02 in microfiche. USGS Water-Data Report FL-90-1A. (USGS/WRD/HD-91/287), 1991. 444p. Prepared in cooperation with the State of Florida and other agencies.

Descriptors: *Data collections, *Florida, *Groundwater, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for the 1990 water year for Florida consist of continuous or daily discharge for 349 streams, periodic discharge for 40 streams, miscellaneous discharge for 75 streams, continuous or daily stage for 105 streams, continuous daily tide stage for 12 sites, periodic stage for 25 streams, peak discharge for 41 streams, and peak stage for 40 streams; continuous or daily elevations for 70 lakes, periodic elevations for 70 lakes; continuous groundwater levels for 441 wells, periodic groundwater levels for 1,229 wells, and miscellaneous water-level measurements for 1,908 wells; quality of water data for 145 surface water sites and 799 wells. The data for northeast Florida include continuous or daily discharge for 164 streams, periodic discharge for 27 streams, miscellaneous discharge for 22 streams, continuous or daily stage for 2 streams, continuous or daily tide stage for 3 sites, periodic stage for 13 streams, peak discharge for 17 streams, and peak stage for 30 streams; continuous or daily elevations for 41 lakes, periodic elevations for 53 lakes; continuous groundwater levels for 76 wells; periodic groundwater levels for 161 wells, and miscellaneous water level measurements for 878 wells; quality-of-water data for 51 surface water sites and 78 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, state and federal agencies in Florida. (See also W90-06332) (USGS)
W91-12644

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990, VOLUME 1. SOUTHERN GREAT BASIN FROM MEXICAN BORDER TO MONO LAKE BASIN, AND PACIFIC SLOPE BASINS FROM TIJUANA RIVER TO SANTA MARIA RIVER.
Geological Survey, Sacramento, CA. Water Resources Div.
J. C. Bowers, R. M. Jensen, and E. B. Hoffman.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-212191. Price codes: A13 in paper copy, A02 in microfiche. USGS Water-Data Report CA-90-1. (USGS/WRD/HD-91/288), 1991. 289p. Prepared in cooperation with the State of California Department of Water Resources and with other agencies.

Descriptors: *California, *Data collections, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for the 1990 water year for California consist of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 1 contains discharge records for 157 streamflow-gaging stations, 16 crest-stage partial-record streamflow stations, and 2 miscellaneous measurement stations; stage and contents records for 16 lakes and reservoirs; water quality records for 19 streamflow gaging stations, 2 partial-record stations; and precipitation records for 13 stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)

W91-12645

WATER RESOURCES DATA FOR INDIANA, WATER YEAR 1990.
Geological Survey, Indianapolis, IN. Water Resources Div.
J. A. Stewart, and G. E. Nell.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-210989. Price codes: A16 in paper copy, A02 in microfiche. USGS Water-Data Report IN-91-1. (USGS/WRD/HD-91/263), 1991. 340p. Prepared in cooperation with the State of Indiana and with other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *Indiana, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for the 1990 water year for Indiana consist of record of discharge, stage, and water quality of streams and wells; reservoir stage and contents; and water levels in lakes and wells. This report contains records of discharge for 181 stream-gaging stations, stage for 7 stream stations, stage and contents for 1 reservoir, water quality for 3 streams and 5 observation wells, and water levels for 80 lakes and 95 observation wells. Additional water data were collected at various sites, not part of the systematic data-collection program, and are shown as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey in Indiana in cooperation with State and Federal agencies. (USGS)
W91-12646

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1989. VOLUME 1: EASTERN NEW YORK EXCLUDING LONG ISLAND.
Geological Survey, Albany, NY. Water Resources Div.
G. D. Firda, R. Lumia, and P. M. Murray.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-217356. Price codes: A22 in paper copy, A03 in microfiche. USGS Water-Data Report NY-89-1. (USGS/WRD/HD-90/310), 1990. 258p. Prepared in cooperation with the State of New York and other agencies.

Descriptors: *Data collections, *Groundwater, *Hydrologic data, *New York, *Streamflow, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water level, Water temperature, Wells.

Water resources data for the 1989 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in observation wells. This volume contains records of water discharge at 93 gaging stations; stage only at 4 gaging stations; and stage and contents at 4 gaging stations, and 19 other lakes and reservoirs; water quality at 38 gaging stations; and water levels at 25 observation wells. Locations of these sites are shown. Also included are data for 37 crest-stage partial-record stations. Additional water data were collected at various sites not in the systematic data collection program and are published as miscellaneous measurements. These data, together with the data in volumes 2 and 3, represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in New York. (See also W90-07846) (USGS)
W91-12647

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1990. VOLUME 4: NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE TO OREGON STATE LINE.
Geological Survey, Sacramento, CA. Water Resources Div.
J. R. Mullen, W. F. Shelton, K. L. Markham, and S. W. Anderson.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-211284. Price codes: A15 in paper copy, A02 in microfiche. USGS Water-Data Report CA-90-1. (USGS/WRD/HD-91/276), 1991. 323p. Prepared in cooperation with the California Department of Water Resources and with other agencies.

Descriptors: *California, *Data collections, *Hydrologic data, *Surface water, *Water quality, Chemical analysis, Flow rates, Gaging stations, Lakes, Reservoirs, Sampling sites, Sediments, Water analysis, Water temperature.

Water resources data for the 1990 water year for California consist of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 4 contains discharge records for 182 gaging stations; stage and contents for 34 lakes and reservoirs; precipitation data for 3 stations; and water quality for 12 stations. Also included is one low-flow partial-record station. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (See also W91-02628) (USGS)
W91-12648

PLANKTON STUDIES IN SAN FRANCISCO BAY, CALIFORNIA, XI. CHLOROPHYLL DISTRIBUTIONS AND HYDROGRAPHIC PROPERTIES OF SAN FRANCISCO BAY, 1988-89.
Geological Survey, Menlo Park, CA. Water Resources Div.
S. M. Wienke, B. E. Cole, and J. E. Cloern.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 90-562, 1990. 212p, 1 fig, 3 tab, 5 ref.

Descriptors: *Chlorophyll, *Data collections, *Estuaries, *Phytoplankton, *San Francisco Bay, Fluorescence, Light, Phaeopigments.

Water samples were collected in the San Francisco Bay estuary during 42 cruises from February, 1988, through December, 1989. Conductivity, temperature, light attenuation (turbidity), and in-vivo fluorescence were measured longitudinally and vertically in the main channel of the estuary from near the Dumbarton Bridge in the extreme southern part to Rio Vista on the Sacramento River. Discrete water samples were analyzed for chlorophyll a. Water density was calculated from values for salinity, temperature, and pressure (depth), and is included in the data summaries. (USGS)
W91-12650

SELECTED DATA FOR STREAM SUBBASINS IN THE WATONWAN RIVER BASIN, SOUTH-CENTRAL, MINNESOTA.
Geological Survey, St. Paul, MN. Water Resources Div.
D. L. Lorenz.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-61, 1991. 7p, 1 plate. Project No. MN 106.

Descriptors: *Drainage area, *Maps, *Minnesota, *Water resources data, *Watonwan River, River basins.

Selected data upstream from selected points on streams in the Watonwan River basin in Minnesota are presented. These data characterize the drainage area, percentage of lake and storage area, stream length, and stream slope of the subbasins. (USGS)
W91-12651

SELECTED DATA FOR STREAM SUBBASINS IN THE LE SUEUR RIVER BASIN, SOUTH-CENTRAL, MINNESOTA.
Geological Survey, St. Paul, MN. Water Resources Div.
D. L. Lorenz.

Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-62, 1991. 8p, 1 plate. Project No. MN 106.

Descriptors: *Drainage area, *Le Sueur River, *Maps, *Minnesota, *Water resources data, River basins.

Selected data upstream from selected points on streams in the Le Sueur River basin in Minnesota are presented. These data characterize the drainage area, percentage of lake and storage area, stream length, and stream slope of the subbasins. (USGS)
W91-12652

TECHNIQUES FOR COMPUTING DISCHARGE AT FOUR NAVIGATION DAMS ON THE ILLINOIS AND DES PLAINES RIVERS IN ILLINOIS.
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W91-12655

ESTIMATES OF ROTIFER PRODUCTIVITY IN LAKE CONSTANCE: A COMPARISON OF METHODS.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2H.
W91-12691

WHAT IS THE BEST TIME REFERENCE TO EXPRESS BIOLOGICAL RESULTS: THE CALENDAR YEAR OR THE ECOLOGICAL YEAR.
Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Inst. de Limonologie.
For primary bibliographic entry see Field 2H.
W91-12709

INTERACTIVE PROGRAM FOR CALCULATING THE ONE-DIMENSIONAL DYNAMICAL TEMPERATURE SIMULATION MODEL 'DYRESM' ON A MACINTOSH COMPUTER.
Carbotech, Zurich (Switzerland).
B. G. Kiefer, and A. Fritschy.
Internationale Vereinigung fuer Theoretische und Angewandte Limnologie. Verhandlungen IVTLAP, Vol. 24, No. 2, p 959-962, March 1991. 7 fig, 2 ref.

Descriptors: *Computer programs, *Lake morphology, *Mathematical models, *Model studies, *Water level, *Water storage, *Water temperature, Calibrations, DYRESM model, Microcomputers, Reservoirs, Storage reservoirs.

The one-dimensional dynamic reservoir simulation Model DYRESM is a powerful tool for the simulation of vertical mass and energy fluxes in small to medium sized lakes with quickly changing surface level and water inlets and offtakes below the water surface, such as natural lakes or artificial pump storage reservoirs. DYRESM was originally designed to run on mainframe computers, but was transferred to a microcomputer with graphic capability, meeting the following conditions: online graphic display of input data and simulation results; easily used user interface allowing interactive definition of the reservoir, calibration parameters and display options; modularity; increased flexibility for interactive definition of inflows and outflows and the length of the simulation period; and optimization of time critical routines to allow sufficiently fast operation. The model was written in FORTRAN, with Modula-2 for the user interface, and runs on the Apple Macintosh II. (Brunone-PTT)
W91-12715

DEMOGRAPHIC ANALYSIS OF TROPICAL ZOOPLANKTON POPULATIONS.
Rhode Island Univ., Kingston. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W91-12762

CHEMICAL DOSING OF SMALL WATER UTILITIES USING REGRESSION ANALYSIS.
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-12820

MODIFIED SOLUTION OF HOMOGENEOUS SURFACE DIFFUSION MODEL FOR ADSORPTION.
Southern Methodist Univ., Dallas, TX. Dept. of Civil and Mechanical Engineering.
For primary bibliographic entry see Field 5D.
W91-12821

LIMESTONE CONTACTORS: STEADY-STATE DESIGN RELATIONSHIPS.
Syracuse Univ., NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W91-12822

HOMOGENEITY OF SPATIAL CORRELATION STATISTICS OF TROPICAL OCEANIC RAINFALL.
Texas A and M Univ., College Station. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W91-12826

APPLICATION AND VALIDATION OF PESTICIDE LEACHING MODELS.
Fraunhofer-Inst. fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W91-12873

APPLYING URBAN RUNOFF MODELS.
Syracuse Univ., NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W91-12879

SYSTEMS APPROACH TO WASTEWATER PERSONNEL TRAINING.
Metcalf and Eddy International, Inc., Alexandria (Egypt).
For primary bibliographic entry see Field 5C.
W91-12884

DYNAMIC MODELLING OF A SINGLE-STAGE HIGH-RATE ANAEROBIC REACTOR--I. MODEL DERIVATION.
Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W91-12916

DYNAMIC MODELLING OF A SINGLE-STAGE HIGH-RATE ANAEROBIC REACTOR--II. MODEL VERIFICATION.
Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W91-12917

8. ENGINEERING WORKS

8A. Structures

COAST EROSION MANAGEMENT--THE KELANTAN CASE.
Waterloopkundig Lab. te Delft, Emmeloord (Netherlands). De Voorst Lab.
For primary bibliographic entry see Field 4D.
W91-11798

KOLNBREIN DAM: AN UNUSUAL SOLUTION FOR AN UNUSUAL PROBLEM.
G. Lombardi.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 6, p 31-34, June 1991. 6 fig.

Descriptors: *Arch dams, *Austria, *Cracks, *Dam stability, *Reservoir operation, Concretes, Dam construction, Neoprene, Rehabilitation, Thrust blocks.

During the initial impounding of the 200 m-high Kolnbrein arch dam (Austria), cracks formed in the upstream heel of the structure. This dam, which is on the Malta River in southern Austria, is a very thin structure with a total water load of 56 GN (or 5,400,000 t). The concrete volume is 1.6 million cubic meters, yielding a slenderness coefficient of 17.5. The dam was built between 1971 and 1977 and it impounds a volume of 200 million cubic meters of water. When the first cracks appeared various remedial measures (eg, grouting, plastic sheeting) were taken, but it became clear that a more radical solution would be required. The remedial measure had to meet two objectives: (1) to increase the dam stability within the cracked zone and (2) to ensure future unrestricted reservoir operation. The solution selected was to install a thrust block at the toe of the dam that should take up a share of the water load (approx 12 GN or 1.2 million t) and at the same time substantially reduce the transverse forces in the dam cantilevers. Six hundred neoprene pads will be used to make a variable opening between the dam and the thrust block. To date the entire concrete volume of the thrust block has been placed and the installation of the neoprene pads and grouting is to occur in 1991. Maximum reservoir level will be reached during 1994. (Rochester-PTT)
W91-12196

WATER, DAMS AND HYDROPOWER IN THE COMING DECADES.
Harza Engineering Co., Chicago, IL.
For primary bibliographic entry see Field 6D.
W91-12197

ANDRE COYNE: A REVIEW OF HIS IDEAS AND THEIR APPLICATION TODAY.
Coyne et Bellier, Paris (France).
J. Billore.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 6, p 47-48, 51, 53-54, June 1991. 6 fig, 19 ref.

Descriptors: *Andre Coyne, *Biographies, *Civil engineering, *Dam construction, Canada, Dams, France, History, Inventions, Portugal, Reinforced concrete, Spillways, Taiwan, Zimbabwe.

Andre Coyne lived from 1891 to 1960. He was an engineer, inventor, and promoter of new ideas. Among his noteworthy accomplishments were: arch dams, 55 of which he designed himself; ski-jump spillways and orifice spillways as well as the combination of dam, powerhouse, and spillway works; vibrating wires; anchored walls ('murs a echelle'); 'Bioge'-type excavations and foundations; and the use of high-capacity active (prestressed) or passive steel reinforcement. Among the projects associated with Andre Coyne are the 181 m-high Tignes dam (France), the 128 m-high Kariba dam (Zimbabwe), the 214 m-high Daniel Johnson dam (Canada), the spillway of Mareges dam in France, and orifice spillways at Castelo do Bode (Portugal), Kukuan (Taiwan) and Kariba. Today, Berke, Tarbela (spillway of tunnel 4), Conqueyrac, and Takamaka are all projects in which the designers have been inspired by ideas developed by Andre Coyne. (Rochester-PTT)
W91-12198

TEXTURED GEOMEMBRANE FOR THE STAGED RAISING OF CERRO DO LOBO DAM.
Knight, Piesold and Partners, Ashford (England).
For primary bibliographic entry see Field 8G.
W91-12199

SURDUC-SIRIU HYDROPOWER PROJECT IN ROMANIA.
Institutul de Studii si Proiectari Hidroenergetice,

Bucharest (Romania).
D. Mihail.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 6, p 79-80, 81, June 1991. 1 fig, 4 tab.

Descriptors: *Dams, *Earthquakes, *Hydroelectric plants, *Rockfill dams, *Romania, *Surduc-Siriu Project, Aqueducts, Bisca Mare River, Ciresu Reservoir, Reservoirs, Siriu Reservoir, Structural engineering.

The Surduc-Siriu scheme in Romania involves two major dams and two hydro plants. The project is being constructed in two phases. The first stage has been completed and the second is now under construction. The development is within the most important seismic epicentral area in Romania, the Vrancea region. The epicenter of the catastrophic earthquake of 4 March 1977 was recorded 19 km downstream from the site of the Siriu dam, which was under construction at the time. The Siriu and Ciresu catchments have, respectively, catchment areas of 681 and 286 sq km and mean flows of 10.6 and 5 cu m/sec. The reservoirs at the two sites will have gross capacities of 155 million cu m (Siriu) and 191 cu m (Ciresu). Dams will be rockfill with respective heights of 122 m and 63 m. Among the purposes to be served by the Surduc-Siriu project are potable and industrial water supply, irrigation, flood control, and hydroelectric power (122 GWh/yr at Siriu, 380 GWh/yr (2 plants) at Ciresu). Like many schemes in Romania, the second stage involves diversion of the flow from several tributaries to increase the discharge available at the hydro plants. The secondary intakes allow for fuller development of the basins. The main second-stage components are: Ciresu dam on the Bisca Mare River, the 4.8 km-long Ciresu-Surdu headrace, Surduc regulating reservoir, a secondary weirs and aqueducts system to increase inflow to the Surduc plant from the Ciresu reservoir, and the Surduc-Niehoisau headrace tunnel, which is 16.75 km long. (Rochester-PTT)
W91-12200

REVIEW OF RESERVOIR FUNCTIONS IN CZECHOSLOVAKIA.
Ceske Vysoke Uceni Technicke v Praze. Katedra Hydrotechniky.
L. Votruba.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 6, p 82-84, 86, June 1991. 4 fig, 2 ref.

Descriptors: *Czechoslovakia, *Dams, *Multipurpose reservoirs, *Surveys, Environmental effects, Hydroelectric power, Irrigation, Minimum flow, Performance evaluation, Reservoir operation, Water supply.

The design of structure with a service life of many decades, such as a dam, should be adaptable to future requirements as much as possible. A study was constructed recently by the Czechoslovak National Committee on Large Dams to assess the extent to which dams and reservoirs in operation are fulfilling their original aims and how they may have surpassed these aims and are serving additional purposes. The average number of functions per reservoir ranges from 4-5.5 for the three regions of Czechoslovakia. The functions are water supply, hydropower production, irrigation, flood control, recreation, fish breeding, maintenance of minimum discharge rates, and releases for flow regulation. The percentage of reservoirs fulfilling their functions ranged from 6% (flow regulation, Slovak Republic) to 94% (flood control, Czech Republic); for most functions and in most areas more than 50% of the reservoirs were fulfilling their functions. Except for irrigation projects and three cases of water supply schemes, the study showed that reservoirs in Czechoslovakia largely fulfill their purposes as planned or exceed their original plans. Comparatively frequent deficiency in the fulfillment of minimum discharge values opens up the question of whether it is more expedient to increase the withdrawals of water and thus lower minimum discharge values with the ensuing impact on the environment. It is concluded that reservoirs constructed between 1953 and 1988 in Czechoslovakia have stood up to their operation tests well and have fulfilled their original design functions. (Rochester-PTT)
W91-12201

STORAGE CAPACITY INCREASED AT BUFFALO BILL DAM.
Bureau of Reclamation, Denver, CO.
D. Dollar, D. Hincliff, L. Pimley, and P. Ruchti.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 7, p 29-31,33-36, July 1991. 7 fig.

Descriptors: *Buffalo Bill Dam, *Concrete dams, *Reservoirs, *Upgrading, *Wyoming, Earth dams, Hydroelectric plants, Hydroelectric power, Multipurpose reservoirs, Shoshone River.

Buffalo Bill dam and reservoir are in northwestern Wyoming, approximately 8 km from the town of Cody. Originally constructed between 1905 and 1910, Buffalo Bill dam is a rubble-concrete structure of constant radius, originally having structural height of 33 m, a crest width of 3 m, and a crest length of 61 m. A major project recently has been undertaken to increase the storage capacity of this arch dam. The objective is to meet future demands for Shoshone River water from local users and to provide for additional hydroelectric power generation. The scheme included increasing the crest height of the dam by 7.6 m, enlarging the spillway, refurbishing the outlet works and the existing Shoshone powerplant, pressurizing an existing underground conduit, and adding a new semi-outdoor powerplant and a new energy dissipation structure with space for a generating unit. When completed, the project will have increased the storage capacity from 490 million cubic meters to 790 million cubic meters and the power generation capacity from 5 MW to an ultimate capacity of 30.5 MW. (Rochester-PTT)
W91-12443

DESIGN EVOLUTION OF THE MOUNT HOPE WATERPOWER PROJECT.
Mount Hope Waterpower Project, Dover, NJ.
F. S. Fisher.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 7, p 37-41, July 1991. 5 fig.

Descriptors: *Hydroelectric plants, *Mount Hope Waterpower Project, *New Jersey, *Pump turbines, *Pumped storage, Construction costs, Cost analysis, Iron mines, Rehabilitation, Reservoirs.

The 2000 MW Mount Hope (New Jersey) Waterpower Project, which is now at the development stage, will be the third largest pumped-storage project in the United States. The station will occupy the site of a disused iron mine. Its interesting features include an underground lower reservoir and five reversible single-stage, high-head pump-turbines. It is the largest hydro project under review for licensing by the Federal Energy Regulatory Commission, and is privately sponsored. The maximum storage volume in both the upper and lower reservoirs will be 6.8 million cubic meters. The generation head is 762 m. The maximum generating capacity, with continuous running on a daily cycle with the upper reservoir full at the start, is 10 GWh. Construction is expected to take 6 yr and to cost $1.8 billion. Start-up is expected in late 1998. (Rochester-PTT)
W91-12444

HGL ELEVATION AT PIPE EXIT OF USBR TYPE VI IMPACT BASIN.
Agricultural Research Service, Stillwater, OK. Water Conservation Structures Lab.
For primary bibliographic entry see Field 8B.
W91-12566

INVESTIGATION OF PROBLEMS OF CONSTRUCTING THE KHUDONI ARCH DAM BY THE CONTINUOUS CONVEYOR TECHNOLOGY.
G. I. Chogovadze, L. P. Trapeznikov, P. V. Chichagua, T. N. Rukavishnikova, and A. D. Chitanava.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 497-499, 1991. 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 13-14, August 1990.

Descriptors: *Arch dams, *Civil engineering, *Concrete construction, *Dam construction, *Khudoni Dam, Concrete plants, Experimental data, Soviet Union, Theoretical analysis.

The Khudoni arch dam is being constructed on the Inguri River, and is designed to achieve a height of 200.5 meters and crest length of 525 meters, and to use a concrete volume of 1,350,000 cubic meters. Theoretical and experimental investigations were conducted to assess the possibility of constructing the dam by a continuous conveyor technology using enlarged blocks to reduce construction time, the number of vertical and horizontal joints, and consequently, the volume of formwork and grouting operations. Results of the calculations performed by the All-Union Scientific-Research Institute of Hydraulic Engineering and Georgian Scientific-Research Institute of Power Engineering and Hydraulic Structures are presented. The calculations show that: (1) the Khudoni hydrostation can be constructed by the continuous conveyor technology using enlarged blocks; (2) the rate of concreting the dam at the proposed block dimensions and time required to cover the blocks can reach 200 to 250 cubic meters per hour; and (3) the indicated rate of concreting will necessitate the construction of a new concrete plant with heating and cooling facilities for the concrete mix near the dam. (Collins-PTT)
W91-12612

REPLACEMENT OF MITER GATES WHEN RECONSTRUCTING NAVIGATION LOCKS.
For primary bibliographic entry see Field 8C.
W91-12613

CATHODIC PROTECTION OF THE PENSTOCKS OF THE MINGECHAUR HYDROELECTRIC STATION.
For primary bibliographic entry see Field 8G.
W91-12614

CONSTRUCTION OF COMPACTED ASPHALTIC CONCRETE CORE WALLS OF EARTH DAMS.
A. A. Ravkin, V. M. Davidenko, and S. V. Gavrilov.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 518-520, 1991. 1 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 27-28, August 1990.

Descriptors: *Asphaltic concrete, *Concrete dams, *Concrete technology, *Dam construction, *Dam design, *Earth dams, Soviet Union, Structural engineering.

In recent years, more asphaltic concrete core walls (ACWs) have been used as the main watertight design element for rockfill dams. The compacted ACW is constructed by means of self-propelled asphaltic concrete placers. As this equipment is not presently available within the USSR, a method was developed for constructing ACWs which utilizes available equipment. The technology requires the preliminary formation of the body of the core wall by means of climbing-traveling forms with subsequent compaction of the asphaltic concrete and soil adjacent to it by a DU-12A tamping machine. The method assumes the core wall will be constructed in tiers of increased thickness which will improve the technical and economic indices and the quality of the core wall. Further development and experimental tests are needed, but the method seems flexible and reliable. (Collins-PTT)
W91-12617

SEEPAGE REGIME IN THE FOUNDATION OF THE SAYANO-SHUSHENSKOE HYDROELECTRIC STATION DAM DURING STAGED FILLING OF THE RESERVOIR.

O. N. Nosova, and O. G. Margolina.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 525-530, 1991. 6 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 32-36, August 1990.

Descriptors: *Arch dams, *Dam design, *Gravity dams, *Hydraulic structures, *Hydroelectric plants, *Piezometers, *Seepage control, *Strain, Drains, Grouting, Sedimentation, Soviet Union, Stress, Water level.

Observations on the seepage processes of hydraulic structures are necessary to verify design calculations, to detect deviations from the calculations during the construction period, and to develop recommendations for a monitoring system during permanent operation. However, the collection of the seepage data in the foundation and bank abutments of dams is technically difficult during construction and the initial period of operation. Due to deviations in the pre-designed field testing and monitoring program during the construction of the high gravity-arch dam of the Sayano-Shushenskoe hydroelectric station, analysis of the seepage flow results is limited to the channel part of the dam. The piezometer measurements indicate that the grout curtain and drainage system at the dam's foundation decrease the uplift pressure at the base of the dam to values less than the design ones. Hydrographs, showing the fluctuation of the water level over time, from the upstream and downstream piezometers were reviewed to evaluate the seepage characteristics and stress-strain state of the dam. However, conclusions about the seepage conditions cannot be drawn based on the discharges from the drain wells. The seepage inhomogeneity of the dam foundation is comparatively large and not taken into account in the seepage conditions; a three-dimensional model would be necessary to resolve this situation. During staged filling of the reservoir, abrupt changes in the permeability occurred along with an increase in fracture porosity and head on the structure at a water filling rate greater than 2 meters per day. The grout curtain and drainage device tends to decrease in effectiveness with time due to decompression of the contact zone from seasonal stress-strain variations and to the intense deposition of sediment in the drain wells. (Collins-PTT)
W91-12619

CAPANDA HYDRO DEVELOPMENT IN ANGOLA.
For primary bibliographic entry see Field 8C.
W91-12622

8B. Hydraulics

NONLINEAR BAROTROPIC TIDES AND BORES IN ESTUARIES.
Delaware Univ., Newark. Coll. of Marine Studies.
A. Munchow, and R. W. Garvine.
Tellus TELLAL, Vol. 43A, No. 3, p 246-256, May 1991. 11 fig, 1 tab, 20 ref. NSF Grant OCE-8711299.

Descriptors: *Estuaries, *Mathematical models, *Seiches, *Tidal bores, *Tidal effects, *Tidal hydraulics, *Tidal waves, *Tides, Channel morphology, Conwy Estuary, Flow velocity, Model studies, Water level.

Observations and modeling of barotropic estuarine tidal dynamics have shown that estuaries are not necessarily simple co-oscillation of the coastal oceans. The propagation of tides from the coastal ocean into shallow estuarine waters often produces characteristic nonlinearly induced asymmetries of velocity and water level in time series. Until recently, a sound physical understanding of related phenomena has been difficult to obtain as flow field data are rare. Numerical studies usually model a single estuary only; the modeled parameter space is often limited. From the vertically averaged governing equations that include nonlinear terms and bottom friction, three dimensionless parameters (the ratio between the tidal amplitude at the estuarine mouth and the mean depth in the estuary, the ratio between the frictional and the tidal length scales, and the ratio between the geometric and the tidal length scales) set the character of the barotropic tidal response for channel-shaped estuaries. A time-dependent numerical model was devised based on the method of Lax and Wendroff. The model was used to explore the response over a wide range of the three parameters. Tidal responses include damped waves, hydraulic regimes, and tidal wave breaking or bore development. Where field data are available, as in the Conwy Estuary, UK, water level and velocity compare favorably with model predictions. (Brunone-PTT)
W91-11642

PERFORATION DIMENSIONS AND EXIT HYDRAULIC GRADIENT EFFECTS ON SEDIMENTATION IN SUBSURFACE DRAINS.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
J. Gallichand, and R. Lagace.
Canadian Agricultural Engineering CAEOAI, Vol. 33, No. 1, p 17-25, January 1991. 7 fig, 5 tab, 26 ref.

Descriptors: *Hydraulic gradient, *Model studies, *Sedimentation, *Soil types, *Subsurface drains, Loam, Sandy soils, Silica.

Laboratory experiments were performed with six drainage simulators to study the effect of drain perforation dimensions and hydraulic gradient at the perforations on the sedimentation level in subsurface drains. Two types of soil were used: a cohesionless fine sand (silica) and a weakly structured sandy loam. Results showed that the level of sedimentation in the drain can be adequately described by a sigmoid model using the drain perforation diameter (R-square=0.75 for the sandy loam, and 0.67 for the silica). For the silica, partial size distributions near the drain were significantly different from one experiment to another. In this case, the introduction in the sigmoid model of a soil factor based on the D-90 size of the soil allowed prediction of the sedimentation level with an R-square of 0.93. For both soil types the sedimentation level, expressed as the mass of sediment entering the drain per perforation, is a function of the perforation diameter but is not affected by the exit hydraulic gradient. Based on the experimental results, it appears that bridging of soil particles or aggregates at drain openings could be more important than the exit gradient in explaining drain sedimentation. (Author's abstract)
W91-11649

NUMERICAL CALCULATION OF EQUIVALENT GRID BLOCK PERMEABILITY TENSORS FOR HETEROGENEOUS POROUS MEDIA.
Chevron Oil Field Research Co., La Habra, CA.
For primary bibliographic entry see Field 2F.
W91-11723

CONVECTIVE ACCELERATIONS AND BOUNDARY SHEAR STRESS OVER A CHANNEL BAR.
California Univ., Berkeley. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2E.
W91-11732

PRESSURIZED STEADY STATE FLOWS FROM HORIZONTAL CYLINDRICAL CAVITIES.
Auckland Univ. (New Zealand). School of Engineering.
For primary bibliographic entry see Field 2G.
W91-11733

MODELING THREE-DIMENSIONAL FLOW ABOUT ELLIPSOIDAL INHOMOGENEITIES WITH APPLICATION TO FLOW TO A GRAVEL-PACKED WELL AND FLOW THROUGH LENS-SHAPED INHOMOGENEITIES.
GeoTrans, Inc., Harvard, MA.
For primary bibliographic entry see Field 2F.
W91-11735

VELOCITY DISTRIBUTION AND BED ROUGHNESS IN HIGH-GRADIENT STREAMS.
Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2E.
W91-11736

ESTIMATION OF FLUID FLOW PROPERTIES FROM THE RESPONSE OF WATER LEVELS IN WELLS TO THE COMBINED ATMOSPHERIC AND EARTH TIDE FORCES.
Wright State Univ., Dayton, OH. Dept. of Geological Science.
For primary bibliographic entry see Field 2F.
W91-11742

COMPARISON OF TURBULENCE CHARACTERISTICS MEASURED IN PIPE AND OPEN-CHANNEL WATER FLOWS (COMPARAISON DE QUELQUES CARACTERISTIQUES DE LA TURBULENCE MESUREES DANS DIVERS ECOULEMENTS D'EAU EN CANAL ET EN CONDUITE).
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
F. Raemy.
Houille Blanche HOBLAB, Vol. 1991, No. 1, p 13-21, 1991. 9 fig, 22 ref. English summary.

Descriptors: *Model studies, *Open-channel flow, *Pipe flow, *Turbulence, Flow velocity, Hydraulic profiles, Mathematical models, Water distribution systems.

Turbulence characteristics of water flowing through rough pipes were compared using data gathered by hot-film anemometry versus data previously obtained by more direct measuring methods. It was observed that the distributions of the turbulence intensities, the probability density of the fluctuating velocity, the eddy viscosity, and the Taylor microscales are generally in good agreement for pipe and open-channel water flows. These results confirm results of the rough pipe investigation. (Author's abstract)
W91-11788

FLOWS AND DISSIPATION OF ENERGY ON GABION WEIRS (ECOULEMENT ET DISSIPATION SUR LES DEVERSOIRS EN GRADINS DE GABIONS).
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Aix-en-Provence (France). Aix-en Provence Group.
L. Peyras, P. Royet, and G. Degoutte.
Houille Blanche HOBLAB, Vol. 1991, No. 1, p 37-47, 1991. 11 fig, 2 tab, 11 ref, append.

Descriptors: *Energy dissipation, *Flow profiles, *Gabions, *Hydraulic properties, *Weirs, Africa, Dams, Energy, Flood flow, Hydraulic models, Hydraulic structures, Stilling basins.

The use of gabions in small dams in the Sahel regions of Africa is quite common, where they are used in flood spillways instead of the usual techniques. Apart from a good mechanical stability and a high level of resistance to flood flows, gabion weirs allow for large amounts of energy to dissipate before the water reaches the stilling basin. Presently the correct dimensions for this type of structure are not well known. To define energy dissipation, a systematic study of standardized wasteways from 3 to 5 m high, with flow rates of up to 3 cu m/s/m width, was carried out on scale models at a 1:5 scale. This study has enabled the amount of energy dissipation to be quantified and the dimensions for the stilling basin to be defined. Results lead to a savings of 10% to 30% over the length of the stilling basin compared to lengths obtained with previously established methods. (Author's abstract)
W91-11790

PROBLEMS OF SILTING IN MOROCCAN PORT ON THE ATLANTIC SIDE: THE SEDIMENTOLOGICAL IMPACT ON THE COAST

(PROBLEMES D'ENSABLEMENT DES PORT MAROCAINS SUR LA FACADE ATLANTIQUE. LEUR IMPACT SEDIMENTOLOGIQUE SUR LE LITTORAL).
Paris-11 Univ., Orsay (France).
C. Latifa.
Houille Blanche HOBLAB, Vol. 1991, No. 1, p 49-71, 1991. 34 fig, 6 tab. English summary.

Descriptors: *Coastal waters, *Morocco, *Sedimentation, *Silting, Forecasting, Hydraulic models, Simulation analysis.

Moroccan ports on the Atlantic side, especially those to the South of Cap Cantin where the coast passage which orients north-south and varies from 250,000 to 800,000 cu m/yr, are having unusually difficult silting and sand problems. Experimental work has been conducted on physical scale models with mobile bottoms to simulate and monitor the sediment trends in this natural setting. After summing up the natural morphologic, meteorologic, oceanographic and sedimentologic phenomena along the coast, this article compares forecasts from models with observations after the event in the natural settings. These comparisons illustrate the different perturbations that port works may cause to the sediment equilibrium of the coast. (Author's abstract)
W91-11791

ESTEVAO CABRAL'S PIONEERING CONTRIBUTION TO OPEN CHANNEL HYDROMETRY.
Technical Univ. of Lisbon (Portugal). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-11794

MODEL SCALING LAWS FOR TUNNELED OCEAN-SEWAGE OUTFALLS.
New South Wales Univ., Kensington (Australia). Water Research Lab.
D. L. Wilkinson.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 547-561, May 1991. 4 fig, 17 ref.

Descriptors: *Hydraulic design, *Hydraulic models, *Model studies, *Ocean dumping, *Tunnel hydraulics, *Wastewater outfall, Buoyancy, Diffusers, Flow, Friction, Froude number, Reynolds number, Seawater, Slopes, Tunnels.

Failure to purge seawater from the diffuser section of ocean outfalls can cause seawater to circulate through the diffuser section of the outfall, reducing the hydraulic efficiency of the outfall. Therefore, hydraulic models are a valuable aid to the design process for ocean outfalls with high risers. Model scaling laws appropriate to these outfalls were developed based on the various physical interactions involved in the purging process. In the riser section of the model, inertia and buoyancy are the principal influences so that the velocity scale is set by the requirement that the densimetric Froude number be the same in the model as in the prototype. In the tunnel, friction, buoyancy and inertia are all important and to offset the relatively greater frictional influence at the lower Reynolds numbers in the model, it is necessary to exaggerate the slope of the model tunnel, equivalent to distorting the vertical scale in a free-surface Froude model. Entrainment plays an important role during certain phases of flow in the tunnel, and correct scaling of the entrained flow determines the length scale for the tunnel. Finally, scaling relationships were developed for model diffusers that were hydraulically equivalent to those of the prototype. This enables simpler diffuser geometries to be employed in the model without altering the purging characteristics of the outfall. (Doria-PTT)
W91-12050

MODEL-DETERMINED DESIGN LOAD ON ACTUATOR COVER PLATE.
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
T. Nakato, and T. A. Lavigne.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 562-578, May 1991. 14 fig, 1 tab, 3 ref. St. Lawrence Seaway Development Corp. Contract DTST 55-84-C-C0436.

Descriptors: *Flushing, *Hydraulic design, *Hydraulic models, *Load distribution, *Locks, *Model studies, *St Lawrence Seaway, Cavitation, Culverts, Navigation, River ice, St Lawrence River.

A 1:16-scale hydraulic model of the actuator cover-plate assembly of the Dwight D. Eisenhower Lock ice-flushing system in the St. Lawrence River, was used to obtain basic design loads for a new assembly design. The ice-flushing bypass system was originally installed in 1981 in the existing filling and emptying culvert. The model investigation included tests of two basic layouts of the cover-plate assembly that failed in the prototype and the determination of preferable configurations based on the measured live-load pressures. The investigation revealed potential for cavitation damage due to extremely high velocities in the main culvert of the lock. The investigation also provided useful engineering data for redesigning the actuator cover-plate assembly. The L-shaped cover-plate assembly was redesigned with a live-load design pressure of 4,000 psf (191,500 N/sq m), excluding the safety factor, to account for nonuniform distributions of pressure on the cover-plate assembly. The new prototype assembly has not experienced any problems in the past seven years. (Author's abstract)
W91-12051

SCOUR DOWNSTREAM OF GRADE-CONTROL STRUCTURES.
Gonzaga Univ., Spokane, WA. Dept. of Civil Engineering.
N. E. Bormann, and P. Y. Julien.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 579-594, May 1991. 7 fig, 3 tab, 39 ref.

Descriptors: *Channel degradation, *Channel scour, *Erosion, *Hydraulic design, *Scour, *Stream stabilization, Alluvial channels, Eddy diffusion, Fluid flow, Jets, Mathematical equations, Particle size, Slopes, Submergence.

Grade-control structures prevent excessive channel-bed degradation in alluvial channels. The erosive action of flowing water, however, causes significant downstream local scour, which may undermine these structures. Structural design considerations must therefore include adequate protective measures against local scour downstream of grade-control structures. A theoretical investigation of local scour downstream of grade-control structures based on two-dimensional jet diffusion and particle stability was verified experimentally. Turbulent jet diffusion reduces fluid velocity near the bed particles and equilibrium scour is obtained when noncohesive bed particles cannot be removed from the scour hole. Equilibrium scour depth is written as a function of velocity, flow depth, and particle size. The theoretically derived equation is remarkably similar to the regression equations reported in the literature. The experimental investigation used a large-scale physical model with unit discharge up to 2.5 sq m/s and scour depths exceeding 1.4 m. When combined with previous data sets at smaller scales, a total of 231 scour-depth measurements cover a wide variety of conditions: wall to vertical jets, small to large flow submergence, and various face angle slopes. The agreement between calculated scour depths and laboratory measurements is satisfactory considering the wide variety of configurations analyzed. (Author's abstract)
W91-12052

ENTROPY-BASED REDUNDANCY MEASURES IN WATER-DISTRIBUTION NETWORKS.
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
K. Awumah, I. Goulter, and S. K. Bhatt.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 595-614, May 1991. 3 fig, 5 tab, 30 ref.

Descriptors: *Design criteria, *Entropy, *Hydraulic engineering, *Optimization, *Water distribution, Cost analysis, Mathematical studies, Pipes, Pumps, Storage.

Reliability and flexibility in the face of failure conditions are implied aspects of redundancy in water distribution networks. Explicit and comprehensive ways to measure either the reliability or redundancy of water distribution networks have not been developed. A measurement of the redundancy inherent in the layout of a water distribution network was developed using an axiomatic approach based upon the desired properties of such a measurement. The measurement was examined in an application to candidate layouts obtained from the solutions of a distribution layout design model. A comparison between redundancy measurements and network performance, as indicated by percentage of flow supplied under a range of link failures, demonstrates that an increase in the value of redundancy, as measured by the entropic parameter, increases the ability of the water distribution network to respond to failure problems in the network. The value of the measurement was demonstrated by its use in the least-cost design of an example network. The method is capable of developing reliable layout and component designs without having to use the large numbers of load patterns or intensive iterative approaches normally required. At the moment, the model is limited to consideration of reliability or redundancy related to pipe failures. Further work is required to develop strategies for including pumps and storage. (Author's abstract)
W91-12053

APPLICATION OF ENTROPY CONCEPT IN OPEN-CHANNEL FLOW STUDY.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
C. L. Chiu.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 5, p 615-628, May 1991. 4 fig, 1 tab, 11 ref.

Descriptors: *Entropy, *Flow characteristics, *Model studies, *Open-channel flow, Channel morphology, Energy, Mannings equation, Probabilistic process, Velocity distribution.

The use of the variational principle to maximize entropy is illustrated for possible applications in the study of open-channel flow. Examples include (1) modeling of velocity distribution by probabilistic formulation and entropy maximization; (2) relating entropy to the parameters of velocity distribution models; (3) relating entropy to the energy and momentum coefficients; (4) relating the mean velocity given by Manning's equation to the velocity distribution and entropy; and (5) relating entropy to the locations of the mean and maximum velocities in a channel cross section. The 'entropy parameter' M and the maximum flow velocity u-max are emphasized as important new parameters. Many flow properties can be expressed in terms of M. Knowledge of u-max is equivalent to knowing the range of flow velocity in a channel cross section, an important statistical parameter, which along with the mean velocity can completely describe the probability-density function of flow velocity and, hence, the velocity distribution and other related flow properties. Such a concept is new to open-channel hydraulics. In a wide channel, u-max usually occurs on the water surface, and hence can be measured easily, although it can also be determined analytically from its relation to other quantities. It would be worthwhile in the future to further investigate u-max and M and their relations to other flow properties. (Author's abstract)
W91-12054

HYDROLOGIC CHANNEL-FLOW ROUTING FOR COMPOUND SECTIONS.
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2E.
W91-12055

DYE-CONCENTRATION DISTRIBUTION IN SHALLOW RECIRCULATING FLOWS.
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-12056

ESTIMATING FLOW THROUGH RIPRAP.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-12058

INFLUENCE OF GEOMETRY ON DISCHARGE CAPACITY OF OPEN CHANNELS.
Ulster Univ., Coleraine (Northern Ireland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-12059

FINITE DIFFERENCE MODELLING OF THE VARIATION IN PIEZOMETRIC HEAD WITHIN A ROCKFILL EMBANKMENT.
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
R. D. Townsend, V. K. Garga, and D. Hansen.
Canadian Journal of Civil Engineering CJCEB8, Vol. 18, No. 2, p 254-263, April 1991. 8 fig, 2 tab, 23 ref, append.

Descriptors: *Canada, *Dams, *Drainage systems, *Flow-through dams, *Model studies, *Piezometric head, *Rock fill, *Rockfill dams, *Rockfill drains, Darcys law, Embankments, Finite difference methods, Hydraulic gradient, Mathematical equations, Mathematical models, Spreadsheets.

The subject of flow through rockfill is of increasing interest in Canada. Rockfill drains are used now by mining companies to permit existing creeks to flow-through the base of mine waste dumps. There is potential for the use of flow-through rockfill dams for mini-hydro schemes because the adoption of a costly concrete spillway may be unnecessary in some cases. An important issue in the design of flow-through rockfill structures is the pore pressure distribution and the associated hydraulic gradients, neither of which are associated with Darcy's law. The finite difference scheme of Curtis and Lawson, which is based on the partial differential equation presented by Parkin and associates in 1966, has been investigated for making these determinations. The effect on the results of using more direct expressions for the edge nodes was examined. Analytical results were compared with observed piezometric heads in the case of two model flow-through rockfill dams. It is shown that through the use of a standard electronic spreadsheet, piezometric heads of non-Darcy form in porous media and the associated hydraulic gradients can be modeled directly without the need for complex computer programming. Applying finite difference expressions associated with Darcy's law for edge nodes provided a workable model for piezometric head even though flow through the embankment was nonlinear. Mean absolute deviations from observed piezometric heads were less than 10%. About 3100 nodes were used for each model; this high density of nodes was considered important to the success of the model. The introduction of an impermeable upstream face on the dam necessitated a greater number of relaxations of the finite difference grid. It was computationally intensive to model the piezometric heads in the zone between the impermeable face and the base of the dam. (Rochester-PTT)
W91-12086

RELIABILITY IMPROVEMENT FOR WATER DISTRIBUTION NETWORKS THROUGH INCREASING PIPE SIZE.
Asian Inst. of Tech., Bangkok (Thailand). Div. of Industrial Engineering and Management.
O. Fujiwara, and H. D. Tung.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1395-1402, July 1991. 3 fig, 1 tab, 21 ref, 2 append.

Descriptors: *Design standards, *Mathematical studies, *Pipes, *Water distribution, Conveyance structures, Hydraulics, Model studies, Pipelines.

Reliability in the design of water distribution networks has recently attracted wide research interest. Numerous measures of reliability and methods for the evaluation of reliability in water distribution networks are available in the literature. A nonlinear maximum flow model is presented which describes the evaluation of reliability. In addition, a method of improving reliability through increased pipe size is presented using marginal reliability and marginal cost is also presented. The ratio of expected maximum total water supplied to total water demanded is employed as the measure of the reliability of a given network design. Reliability improvement is achieved by means of increasing pipe size, the selection of the link to be increased determined by comparing marginal reliability and marginal cost with respect to the pipe size increase. The method proposed gives a clear physical meaning to the measurement of reliability and its improvement. Moreover, a symmetric design is obtained if the system is symmetric. Shortcomings of the method are the excessive computational time and the definition of flow capacity. Computational time may be reduced by truncating the reliability expression, higher-order term being added until the lower and upper bounds become so close that it is not necessary to consider further terms, to approximate reliability. Although flow capacity defined as a function of the maximum allowable hydraulic gradient has a physical basis, it may need further consideration. (Lantz-PTT)
W91-12316

THEORETICAL ANALYSIS OF FLOW RATE INTO PERFORATED DRAIN TUBES.
Lakehead Univ., Thunder Bay (Ontario). Dept. of Civil Engineering.
G. Hazenberg, and U. S. Panu.
Water Resources Research WRERAQ, Vol. 27, No. 7, p 1411-1418, July 1991. 6 fig, 11 ref, append.

Descriptors: *Drainage engineering, *Drainage systems, *Flow rates, *Pipes, *Theoretical analysis, Drainage, Hydraulic profiles, Laplace equation, Mathematical equations, Mathematical studies.

Perforated drain tubes have, in many places, supplanted the use of drain tiles in drainage from agricultural lands, airports and the like. However, the few existent formulae for predicting drainage rates are complex and unwieldy. A formula was derived by using a series solution of Laplace's equation and techniques of solution of dual trigonometric series, for the rate of water flow into a perforated drain tube, showing the effects of such parameters as hole size, number and spacing of holes, and drain size and depth. The formula applies to pipes perforated by small circular holes or by longitudinal slits. Results of the numerical analysis indicate that having many long, narrow slits in the drain tube is preferable to having fewer circular holes, since a much better approximation to a porous drain is obtained. (Author's abstract)
W91-12318

NEW PERSPECTIVE ON THE VEDERNIKOV NUMBER.
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W91-12351

FLOW RESISTANCE OF RIPRAP.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. T. Maynord.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 6, p 687-696, June 1991. 1 fig, 3 tab, 23 ref, 2 append.

Descriptors: *Channel flow, *Flow resistance, *Hydraulic engineering, *Hydraulic roughness, *Riprap, Channel scour, Flumes, Mathematical equations, Particle size, Water level.

Flow resistance coefficients are essential in determining the water surface elevations and velocities used in many aspects of channel design. Channel boundaries requiring scour protection are often armored with riprap revetments that have roughness characteristics that differ from other channel boundaries. Resistance of flow over riprap boundaries was determined from flume data and compared to the logarithmic and power law equations. Results show that the power law equation is applicable to intermediate scale roughness of riprapped surfaces. The logarithmic equation is applicable to small-scale roughness with K sub s (equivalent sand grain roughness) on the order of 2(D sub 90), where D sub 90 is the particle diameter from which 90% of particles are finer. The power law equation can be used for most riprap problems, which covers the range (flow depth)/(D sub 90) from 3 to 30 without significant error. Use of particle size D sub 90 gives slightly better results than use of D sub 50. Strickler's equation was derived from the power law equation and found to compare favorably with the results of other investigators. Results are applicable to riprap placed with a relatively smooth surface typical of projects constructed in dry conditions. (Author's abstract)
W91-12355

UNSTEADY PRESSURE-DRIVEN VISCOUS FLOWS BENEATH CONCRETE PAVEMENT SLABS.
Florida Univ., Gainesville. Dept. of Mechanical Engineering.
E. C. Hansen.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 6, p 713-724, June 1991. 10 fig, 8 ref, append.

Descriptors: *Highways, *Hydraulic engineering, *Paving, *Pumping, *Unsteady flow, *Viscous flow, Erosion, Florida, Flow velocity, Mathematical equations, Reynolds number, Shear stress, Velocity distribution, Viscosity.

Water pumping flows beneath concrete pavement slabs were measured experimentally and modeled mathematically. A solution for the velocity profile and the wall shear stress was found for the condition of a constant imposed pressure gradient. The solution shows that the core flow is not significantly affected by viscosity. A finite difference method was used to determine the velocity profile and wall shear stress when the imposed pressure gradient is an arbitrary function of time. The velocity profile was then calculated using experimental pressure data for flow beneath a concrete pavement slab. The experimental pressure data was obtained from a 189,000-N three-axle truck crossing the joint between two concrete pavement slabs of I-10 in Florida. Peak water velocities of 0.9 m/s were measured beneath a pavement slab; similar velocities were calculated using measured pressure data. The Reynolds number of the flow was approximately 560. The peak wall shear stress was estimated to be less than 14 Pa. This stress was about half that required for erosion of the soil cement subbase. As a vehicle crosses the transverse joint, the water beneath the pavement slab first moves slowly (0.2 m/s) in the vehicle direction and then moves rapidly (0.9 m/s) backward. (Author's abstract)
W91-12357

INTERNAL WAVE ACTIVITY IN ROTTERDAM WATERWAY.
British Columbia Univ., Vancouver. Dept. of Oceanography.
J. D. Pietrzak, C. Kranenburg, G. Abraham, B. Kranenborg, and A. van der Wekken.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 6, p 738-757, June 1991. 15 fig, 28 ref, append.

Descriptors: *Estuaries, *Internal waves, *Kinetic energy, *Rotterdam Waterway, *Turbulent flow, Acoustics, Density, Hydraulic jump, Mathematical models, Mixing, Profiles, Stratification, Tidal currents, Topography, Velocity, Wave propagation, Waves.

A variety of internal wave mechanisms was observed in the partially mixed Rotterdam Waterway estuary due to the interaction between stratified tidal flow and topography. The topographically generated waves include lee waves, resonant trapped waves and critical layers, freely propagating waves, breaking internal hydraulic jumps at the banks, and rotor formation. Acoustic images and profiles of density and velocity were obtained. These acoustic images were then interpreted on the basis of basic internal wave theory. Mathematical models tend to ignore small-scale internal wave activity as a source of turbulent kinetic energy; the data from the Rotterdam Waterway were used to investigate whether this is justified on the scale of the topography. On the basis of an estimate of the internal wave-induced propagation of turbulent kinetic energy, it was concluded that for the observed internal waves, this source of energy may not always be neglected when compared with the production by the background flow, particularly when first-mode short internal waves are involved. (Author's abstract)
W91-12359

WITHDRAWAL FROM TWO-LAYER FLUID THROUGH LINE SINK.
Western Australia Univ., Nedlands. Dept. of Mathematics.
G. C. Hocking.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 6, p 800-805, June 1991. 3 fig, 1 tab, 20 ref, append.

Descriptors: *Drawdown, *Froude number, *Selective withdrawal, *Sink drains, Density, Hydraulic properties, Interfaces, Mathematical analysis.

Water withdrawn from the lower layer of a fluid consisting of two or more homogeneous layers of different density will flow from the lower layer until some critical value of the Froude number is reached. At larger values of the Froude number, the interface between the two layers is drawn down into the sink, and water from the upper layer begins to flow. There is still some uncertainty about the critical value of the Froude number. Experiments were performed to obtain the critical drawdown Froude number for a line sink in the bottom corner of a rectangular tank containing two layers of fluid of different density over a range of different interface thicknesses. A Froude number (F sub d) based on interface thickness was defined. There is a clear trend for an increase in critical Froude number as the inverse of F sub d decreases. A lower bound on the critical value can be found by taking a linear fit through the data and then considering the limit as the inverse of F sub d approaches zero. This gives a value of F = 0.46 as a lower bound on the critical value for a very thin interface. The fact that it is a lower bound suggests that the actual critical value of Froude number with an infinitesimal interface may be larger, which would put it nearer to the results obtained numerically. (Doria-PTT)
W91-12363

LAWS OF RESISTANCE OF PIPE FLOW OF SOLID-LIQUID MIXTURES.
Yamanashi Univ., Kofu (Japan). Dept. of Civil Engineering.
Y. Ogihara, and N. Miyazawa.
Journal of Hydraulic Research JHYRAF, Vol. 29, No. 2, p 189-205, 1991. 14 fig, 1 tab, 5 ref.

Descriptors: *Fluid flow, *Friction, *Pipe flow, *Resistance, *Reynolds number, *Sediment transport, Bentonite, Deformation, Flow, Fluid dynamics, Head loss, Hydraulics, Laminar flow, Pipelines, Plug flow.

The pipe flow of Bingham fluids was analyzed using a modified Buckingham-Reiner equation in order to establish a basic theory for the pipe flow of solid-liquid mixtures. An extended Reynolds number was introduced so that a Moody diagram could be used for non-Newtonian fluids without any modification. Experiments were carried out using mixtures of water and bentonite. The laws of frictional resistance in pipelines were found to hold when the ordinary Reynolds number was replaced with the given extended Reynolds number. A dimensionless coefficient included in the extended Reynolds number was determined, which has values in the range of 1/8 to 1/6 in laminar flow. It was also found that the coefficient of head loss due to the sudden enlargement for these mixtures was about 11 times larger than the coefficient for water, and the coefficient of head loss due to a bend was about 8 times larger. These increases occurred because both deformation and a break of the plug flow occur at those sections. The coefficient for head loss due to sudden enlargement becomes about 8 times larger as the Reynolds number decreases. These experimental results agree well with the Buckingham-Reiner equation, and confirm the validity of the experimental procedure. (Doria-PTT)
W91-12367

STRUCTURE OF FLOW IN HYDRAULIC JUMPS.
Alberta Univ., Edmonton. Dept. of Civil Engineering.
D. Long, N. Rajaratnam, P. M. Steffler, and P. R. Smy.
Journal of Hydraulic Research JHYRAF, Vol. 29, No. 2, p 207-218, 1991. 12 fig, 3 ref.

Descriptors: *Eddies, *Flow velocity, *Hydraulic jump, *Open-channel flow, *Vortices, Channel flow, Flow characteristics, Fluid dynamics, Fourier analysis, Froude number, Hydraulics, Turbulent flow, Water depth.

For a hydraulic jump formed in a wide horizontal rectangular channel of constant width, the generally accepted view is that a high velocity jet flows along the bed, diffusing as a plane turbulent wall jet under a longitudinal adverse (piezometric) pressure gradient with an aerated recirculating roller on top. The length of this surface roller is smaller than the length of the jump. The large-scale eddy features of hydraulic jumps with supercritical Froude numbers from 4 to 9 were examined using a high-speed (2,000 frames per second) video camera. The surface roller in the upper part of the hydraulic jump was found to be made up of several vortices, with their sizes increasing from the toe to the downstream end. These vortices grow by vortex pairing as they move downstream, with the largest vortex stationed near the end of the (generally accepted) surface roller. The growth and downstream travel of these vortices appear to cause a water spill that runs down the slope causing the toe to move upstream. A Fourier analysis of the time series of the toe revealed the existence of several dominant frequencies, which appear to scale with the inlet velocity and downstream depth. Observations of a hydraulic jump in a field situation indicated that these vortices occupy only a part of the channel width, and that the effect of the sidewalls on the vortices was not significant. (Doria-PTT)
W91-12368

SHALLOW WATER FLOW WITH CYLINDRICAL SYMMETRY.
Reading Univ. (England). Dept. of Mathematics.
P. Glaister.
Journal of Hydraulic Research JHYRAF, Vol. 29, No. 2, p 219-227, 1991. 5 fig, 3 ref.

Descriptors: *Dam failure, *Flow profiles, *Hydraulics, *Shallow water, Algorithms, Computers, Costs, Dams, Mathematical analysis, Model studies.

To solve shallow-water flow equations, much success has been achieved using numerical schemes for hyperbolic conservation laws that update the solution by using the information obtained from solving local Riemann problems at the interface between computational cells. An extended version of a similar scheme was applied to two-dimensional shallow water equations with cylindrical symmetry. Applying the scheme to a test problem involving a converging cylindrical bore, the development of the bore and its approach to the origin was observed; it was subsequently reflected and then propagated out. With 100 mesh points, the time required to compute the results on an Amdahl V/7 was 0.005 c.p.u. seconds for one time step, and a total of 0.8 c.p.u. seconds to reach a real time of 0.12 using 160 time steps. A minor modification to the algorithm allowed for a variable (adaptive) time step and enabled the total amount of computing time to be reduced. A second test problem included the breaking of a circular dam, which includes the reflection of the resulting bore. The development of the bore and its depression wave were observed along with the weakening of the shock wave as it traveled outward. It was concluded that the scheme can be used for cylindrically symmetric problems with confidence. Moreover, it can be used as an inexpensive comparison with results from two-dimensional schemes by choosing a large number of mesh points for accuracy (Doria-PTT)
W91-12369

NUMERICAL MODELLING OF TIDAL MOTION IN SINGAPORE STRAIT.
National Univ. of Singapore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W91-12370

GRAVITY CURRENTS ADVANCING INTO A COFLOWING FLUID.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Hydromechanik und Wasserwirtschaft.
J. Buhler, S. J. Wright, and Y. Kim.
Journal of Hydraulic Research JHYRAF, Vol. 29, No. 2, p 243-257, 1991.

Descriptors: *Density currents, *Fluid mechanics, *Gravity flow, *Hydrodynamics, *Velocity, Boundary flow, Energy, Flow velocity, Fluid dynamics, Jets.

Intrusions into an air or water body can be caused by differential heating and other geophysical processes. Tidal jets in coastal water or density currents due to starting inflows into a reservoir give rise to intrusions preceded by a front, which eventually move along a boundary if the ambient fluid is unstratified. The motion of the front of plane gravity currents spreading on a horizontal floor can be analyzed by neglecting any energy dissipation in the intruding fluid. Results from one previous such analysis for the maximum intrusion depth and the front velocity were, however, not in gocd agreement with actual measurements. This disagreement was partially resolved by choosing a different definition of the flow scales. Two important aspects of this solution are, however, that no energy dissipation occurs within the intruding fluid, and that the velocity distribution far in the lee of the front is uniform in both layers. These assumptions do not appear to be justified for gravity currents moving over a solid surface. A new range of solutions was found by assigning all energy dissipation to the intruding fluid instead, and by allowing for nonuniform velocity distributions. Experimental data were used to relate the energy dissipation to the discharge in the two layers. Further evidence is needed to confirm the existence of intrusions thicker than one-half the water depth. (Doria-PTT)
W91-12371

SEDIMENT TRANSPORT OF FINE SANDS AT HIGH VELOCITIES.
Ministry of Transport and Public Works, Dordrecht (Netherlands).
L. Voogt, L. C. van Rijn, and J. H. van der Berg.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 7, p 869-890, July 1991. 12 fig, 3 tab, 15 ref.

Descriptors: *Flow velocity, *Hydraulics, *Model studies, *Sediment transport, Estuaries, Flumes, Hydraulic models, Mathematical models, Sand, Sediment-water interfaces, The Netherlands, Tidal energy.

Tidal channels in the Netherlands have been closed by pumping fine sand, dredged elsewhere in the estuary, through pipelines in the closure gap of the channel. A successful closure requires that the

sand-delivery capacity exceed the eroding capacity of the tidal flow into the channel, especially in the final closure stage. In the final closure stage, the use of applied sand-transport predictors was questioned. Consequently, the predictive capability of the sediment-transport formulas of Ackers-White, Engelund-Hansen, and van Rijn at high flow velocities is investigated. Total-load transport at high velocities over a fine sand bed (100 to 400 micrometers) is studied by analyzing data from the literature and data from new flume and field measurements. Flume experiments were performed to measure flow velocity and sand concentration profiles in a self-eroding flow initially free of sediment. The flow velocities were up to 2.7 meters per second. A two-dimensional vertical mathematical model for suspended sediment was applied to compute the equilibrium transport rates. Finally, predicted transport rates are compared with transport rates under flume and field conditions. The formulas of Engelund-Hansen and van Rijn predict transport rates that are in reasonable agreement with the measurements. (Author's abstract)
W91-12562

WAKE VORTEX SCOUR AT BRIDGE PIERS.
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
M. A. Stevens, M. M. Gasser, and M. B. A. M. Saad.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 7, p 891-904, July 1991. 9 fig, 2 tab, 26 ref. U. S. Agency for International Development, Contract No. 263-0132.

Descriptors: *Bridge construction, *Channel scour, *Erosion, *Flow around objects, *Piers, *Scour, *Vortices, Cairo, Egypt, Nile River, Sand, Sediment transport.

At most bridges, wake vortex scour is insignificant and confluence scour does not exist. In clear-water rivers flowing on fine sand, these two forms of local scour can be very large. The deep scour holes downstream from the large circular piers (10 and 15 meters in diameter) at the Tahrir and Imbaba Bridges over the Nile River in Cairo, Egypt were produced by the conflicting velocity fields at the intersection of the wake vortex streams from adjacent piers. The depths of scour due to these wake vortices are now 8 to 11 meters where the normal depth of flow is approximately 8 meters. Confluence scour where the main and side channel join upstream from the Imbaba Bridge was 9 meters in 1981 and 1987 and was aligned with the bisector of the intersection angle of the two channels. These depths of scour can be considered nearly clear-water scour as the bridges are in the backwater of the Delta Barrages, the velocity is less than one meter per second, and the sediment transport is very low. (Author's abstract)
W91-12563

HYDRAULIC JUMP IN SLOPING CHANNELS.
Nihon Univ., Tokyo. Dept. of Civil Engineering.
I. Ohtsu, and Y. Yasuda.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 7, p 905-921, July 1991. 16 fig, 1 tab, 12 ref.

Descriptors: *Energy dissipation, *Fluid mechanics, *Hydraulic engineering, *Overflow channels, *Spillways, Critical flow, Froude number, Mathematical studies, Rapid flow, Tranquil flow.

To dissipate the energy of a high-speed discharge flowing down the spillway, it is common to use a hydraulic jump-type energy dissipator. If the downstream depth is larger than the subcritical sequent depth for a classical jump, the control of the hydraulic jump by a sloping apron is useful as a spillway energy dissipator. The transition from supercritical to subcritical flow in sloping channels is systematically investigated under a wide range of slopes. The hydraulic conditions for the formation of D-jump, where the entire jump is formed on the slope, and B-jump, where the jump is formed partly in the sloping portion and partly in the horizontal channel portion, are determined. Also, practical equations for the sequent depths and the length of the jumps are proposed. For the streamwise decay of the maximum velocity in the transition zone, the analogy with the wall jet is discussed. (Author's abstract)
W91-12564

CRITICAL SUBMERGENCE IN TWO-LAYER STRATIFIED FLOW.
Memorial Univ. of Newfoundland, St. John's. Faculty of Engineering and Applied Science.
J. J. Sharp, and T. M. Parchure.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 7, p 924-928, July 1991. 2 fig, 7 ref.

Descriptors: *Cooling water, *Electric powerplants, *Intakes, *Stratified flow, *Submergence, *Thermal stratification, Design criteria, Hydraulic engineering, Mathematical studies, Temperature.

Selective withdrawal from a two-layer stratified flow is particularly important for many power stations drawing cooling water from stratified sources. In many cases the source has become stratified by thermal processes that set up a relatively thin, warm surface layer with a sharp transition across the thermocline to a more dense, cool, bottom layer. For efficient operation it is important to draw water primarily from the cool, lower layer, and a considerable number of experimental studies have been conducted to identify the conditions under which surface water will begin to be drawn into the intake. Visual observations show that a sudden downward bulge develops in the interface just before the intake begins to draw water from the upper layer which is referred to as incipient drawdown or critical submergence. Experimental results and mathematical analysis are presented which suggest that it is unnecessary to operate cooling water intakes so that water from a warm surface layer never penetrates into the intake. Under some circumstances, for example during times when water levels fall for a short period, it should be acceptable to design for the small temperature increases that would be caused by a one percent withdrawal from the surface layer. This relaxation of the condition for critical submergence can lead to acceptability of significantly lower water levels than would otherwise be permissible. Similarly, the intake may draw substantially greater quantities of cooling water without increasing in size. These changes may offer significant design advantages and may result in lower overall cost. (Collins-PTT)
W91-12565

HGL ELEVATION AT PIPE EXIT OF USBR TYPE VI IMPACT BASIN.
Agricultural Research Service, Stillwater, OK. Water Conservation Structures Lab.
C. E. Rice, and K. C. Kadavy.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 117, No. 7, p 929-933, July 1991. 4 fig, 3 ref.

Descriptors: *Elevation, *Energy dissipation, *Hydraulic grade, *Pipe flow, *Spillways, Experimental data, Hydraulic engineering, Inlets, Mathematical studies.

Tests conducted on a model of a Soil Conservation Service (SCS) designed, principal spillway make it possible to determine the design discharge hydraulic grade line (HGL) elevation at the pipe exit to the U. S. Bureau of Reclamation (USBR) Type VI impact basin. The principal spillway, a nonstandard design, has a two-stage covered drop inlet with baffle trash racks. The low stage consists of four orifices that occupy half the length of each side. The pipe through the dam is 2.13 meters in diameter. The outlet structure, a USBR Type VI impact basin energy dissipator, was designed after criteria in SCS Technical Release No. 49. The design discharge is about 45.8 cubic meters per second. A model study was conducted to evaluate the performance of the proposed drop inlet and impact basin and to determine the entrance-loss coefficient for the drop inlet and transition section upstream of the pipe. Measurement of the HGL elevations provided opportunity to establish a relationship to predict the HGL at the pipe exit. This relationship permits accurate determination of the head for flow computations. (Collins-PTT)
W91-12566

DESIGN AND USE OF INTEGRATING HEADER PITOT GRIDS.
G. A. Chepaikin.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 487-490, 1991. 2 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 7-8, August 1990.

Descriptors: *Flow measurement, *Flow velocity, *Hydraulic engineering, *Hydraulic systems, *Mathematical studies, *Pressure-measuring instruments, Flow rates, Instrumentation, Manometers, Pipe flow.

During hydraulic investigations, parameters such as pressure, velocity, and specific energy are sometimes measured at a large number of points of flow. Depending on the parameter, a group of fixed piezometric or velocity tubes are used to obtain the measurements. Each tube installed at a point of flow terminates at its own individual manometer. While this method is justified when distribution diagrams of a parameter are necessary, for instances when only the mean or total value of the parameter over the cross section or part of the boundary surface of the flow is required, the method results in unjustifiable time and costs. By connecting the tubes with one or more headers (depending on the number of types of measuring holes) to one simple or differential manometer, the cost and time for determining the mean or total value of the investigated parameter is minimized. The relation between the flow rate of a fluid through a hole and the difference of pressures before and after a hole as well as the design requirements of the header system are described. The method, based on cumbersome theoretical computations, is simple in design, convenient to use, and provides an instantaneous reading from one manometer of the integral value being sought. The method is applicable to both steady and variable operating regimes in hydraulic systems. When piezometric tubes are joined by a common header, the measurements produce a value close to the average pressure in the flow. (Collins-PTT)
W91-12610

8C. Hydraulic Machinery

MODEL-DETERMINED DESIGN LOAD ON ACTUATOR COVER PLATE.
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 8B.
W91-12051

STATUS AND PROSPECTS OF HYDROPOWER IN AUSTRIA.
Oesterreichische Elektrizitaetswirtschafts A.G., Vienna.
G. Schiller, and F. Drexler.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 6, p 23-24, 27-29, June 1991. 6 fig, 1 tab, 7 ref.

Descriptors: *Austria, *Hydroelectric power, Biomass, Design criteria, Energy, Environmental engineering, Environmental impact, Mitigation measures, Reservoirs, Water quality control.

The most important renewable resource in Austria is hydropower. In 1990 a total of 32,491 GWh of electricity was generated by hydropower and 17,919 GWh was generated by thermal power. The highest rates of increase in hydropower in Austria occurred during the period 1977-1983, when about 1000 GWh/yr was being added. Although hydropower is a clean form of energy, it nevertheless has raised environmental concerns. At present, only 19.1% of CO2 emissions arise from thermal power and district heating powerplants. This percentage would rise to 47.1% without hydropower plants. Known and projected stocks of oil and gas, as well as usable coal stocks, are negligible compared to future national energy needs. Therefore, in the future hydropower and biomass will have to make a major contribution to national energy produc-

tion. Numerous measures have been taken to make hydropower plants more environmentally acceptable. These include shaping banks to avoid monotony, designing storage reservoirs with wet biotopes and shallow-water biotopes, and incorporate other purposes, such as river training, flood protection, and tourism into hydropower facilities. (Rochester-PTT)
W91-12195

WATER, DAMS AND HYDROPOWER IN THE COMING DECADES.
Harza Engineering Co., Chicago, IL.
For primary bibliographic entry see Field 6D.
W91-12197

SURDUC-SIRIU HYDROPOWER PROJECT IN ROMANIA.
Institutul de Studii si Proiectari Hidroenergetice, Bucharest (Romania).
For primary bibliographic entry see Field 8A.
W91-12200

FORECASTING IN OPTIMIZING DUAL SYSTEM FOR ENERGY GENERATION AND IRRIGATION.
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
For primary bibliographic entry see Field 4A.
W91-12202

AUTOMATIC CONTROL SYSTEM OF HYDROELECTRIC POWER STATIONS (LES EQUIPEMENTS DE CONTROLE-COMMANDE DES OUVRAGES HYDRAULIQUES D'ELECTRICITE DE FRANCE).
J. Lecouturier.
Houille Blanche HOBLAB, Vol. 1991, No. 2, p 109-116, 1991. 7 fig, 5 ref. English summary.

Descriptors: *Automation, *France, *Hydroelectric plants, *Water resources management, Computers, Electric powerplants, Management planning, Powerplants, Remote control.

In this era of nuclear production, hydroelectric power stations are no longer used as the main source of electrical energy but, to a large extent, they allow for greater dynamics within the electrical network because of their availability, flexibility and rapidity. At present, Electricite de France (EDF) operates several hydroelectric powerplants, most of which have automatic remote controls and no local operator. The main powerplants are operated from a central Valley hydraulic station. A renovation of the control systems of the large plants will be necessary in the upcoming years. These renovations will take place as a part of the automatic control, generating and transmission system, and the implementation of the new dispatching of energy (the CASOAR project). (Author's abstract)
W91-12413

REMOTE CONTROL OF HYDRAULIC POWER STATIONS FROM 'POSTES HYDRAULIQUES DE VALLEES' (P.H.V.) (LES POSTES HYDRAULIQUES DE VALLEES AU GROUPE REGIONAL DE PRODUCTION HYDRAULIQUE 'ALPES').
P. Verrier.
Houille Blanche HOBLAB, Vol. 1991, No. 2, p 117-122, 1991. English summary.

Descriptors: *Computer programs, *Hydroelectric powerplants, *Remote control, *Water resources management, Automation, Computers, Electric powerplants.

A dozen hydraulic power stations, some of which are very important nationally, are or will be remote controlled from two Postes Hydrauliques de Vallees (P.H.V.). This paper looks at the steps which were taken to realize the creation of the computerized command system installed both at the P.H.V. and at the power stations. The purpose was to create a standard of software program to direct all operations common to all P.H. V., and to all power stations. (Author's abstract)
W91-12414

REMOTE CONTROL OF RIVER RHINE PLANTS (LA TELECONDUITE DES USINES DU RHIN).
P. Laurencon.
Houille Blanche HOBLAB, Vol. 1991, No. 2, p 123-128, 1991. 3 fig. English summary.

Descriptors: *Hydroelectric powerplants, *Remote control, *Rhine River, *Water resources management, Competing use, Electric powerplants, France, Germany, Management planning, Navigation.

The Rhine River (French-German portions) has 10 hydroelectric developments built from 1932 to 1977. Further exploitation is restricted by the navigational needs along the river. The present operating system enables an accounting of these restrictions, and it ensures daily modulations of powerplant production. The 'Poste de Securite du Rhin', set up in Kembs since 1976, is the chief organ of this control system. It will be changed when the 'Poste hydraulique de valle' goes into affect in 1994. (Author's abstract)
W91-12415

REMOTE CONTROL OF BEAUVOIR AND SAINT-HILAIRE PLANTS (ISERE) (TELECONDUITE DES AMENAGEMENTS DE BEAUVOIR ET SAINT-HILAIRE (ISERE)).
C. Bejuy.
Houille Blanche HOBLAB, Vol. 1991, No. 2, p 129-130, 1991.

Descriptors: *Beauvoir Hydroelectric Plant, *Hydroelectric powerplants, *Remote control, *Saint-Hilaire Hydroelectric Plant, *Water resources management, Automation, Electric powerplants, France, Hydraulic gates, Powerplants.

The Beauvoir and Saint-Hilaire hydroelectric plants are part of a chain of six plants called the 'Basse Isere' chain, located downstream from Grenoble, France. These facilities are of the 'low head' type, and have dams equipped with three fixed wheel gates and three surface gates; they are located near the powerplant equipped with three identical Kaplan groups. The application presented in this paper deals with automating their remote control, and supervising the remote control operations from the Pizancon hydraulic monitoring station. (Author's abstract)
W91-12416

AUTOMATIC CONTROL OF THE RANCE TIDAL PLANT (CONDUITE AUTOMATIQUE DE L'USINE MAREMOTRICE DE LA RANCE).
S. Vallee Poussin.
Houille Blanche HOBLAB, Vol. 1991, No. 2, p 131-140, 1991. 5 fig. English summary.

Descriptors: *Automation, *Hydroelectric powerplants, *Tidal powerplants, *Water resources management, France, Powerplants.

The Rance tidal power station was inaugurated in November 1966. A PDP8 computer was installed in 1968 in order to assist shift operators responsible for the power station control. This paper describes the refurbishing of the computerized control system, making it possible for the automatic control system to work together with shift suppression. After a description of the station exploitation modes, basic principles of process control system architecture and functions are illustrated. The main characteristics of the data processing system, show the actual design of an automatic control system for a large size tidal power station. (Author's abstract)
W91-12417

REMOTE CONTROL AND AUTOMATION OF HYDRO POWER PLANTS (TELECOMMANDE ET AUTOMATISME DANS LES USINES HYDRO-ELECTRIQUES).
J. M. Ferme.
Houille Blanche HOBLAB, Vol. 1991, No. 2, p 141-144, 1991. English summary.

Descriptors: *Automation, *Hydroelectric powerplants, *Remote control, *Speed governors, *Water resources management, Computer programs, Computers, Monitoring, Powerplants.

Speed governors are a key element in the automation of hydroelectric powerplants. New functions and new services have been linked to these achievements, while continuously improving the basic performance of speed governors. Industrial equipment has taken advantage of technological progress, especially the creation of microelectronics. This applies to digital communications which enables shared information to be utilized for other applications. The development of DIGIPID speed governors is progressing in the same fashion. After a brief description of these basic improvements, new services are described which provide information on the following STATUS setting and monitoring functions: aided setting, continuous measures while operating the unit, aided maintenance, and remote monitoring. (Author's abstract)
W91-12418

HYDRAULIC TURBINE MONITORING (MONITORING DE TURBINE HYDRAULIQUE).
Neyrpic, Grenoble (France).
D. Khaletzky.
Houille Blanche HOBLAB, Vol. 1991, No. 2, p 145-147, 1991. English summary.

Descriptors: *Computer programs, *Computer-aided design, *Hydraulic turbines, *Monitoring, *Turbines, Data storage and retrieval, Hydraulic equipment, Hydroelectric powerplants.

The early detection of unit failure greatly increases its reliability. To detect failure early, an accurate knowledge of the unit behavior is required. This knowledge can be increased with computer-aided data storage and analysis. However, its success depends on making good choices of sensors, and efficient methods of data analysis. A concrete approach is proposed which would set up a progressively accurate and efficient method for remote unit supervision. (Author's abstract)
W91-12419

HYDROMETEOROLOGICAL FORECASTING AND REMOTE CONTROL AT ELECTRICITE DE FRANCE (PREVISION ET TELESURVEILLANCE HYDROMETEOROLOGIQUE A EDF).
Electricite de France, Grenoble. Div. Technique.
For primary bibliographic entry see Field 7B.
W91-12420

TELEMETERING SYSTEM SCHTROUMPH AT EDF (LE SCHTROUMPH A EDF: SYSTEME DE COLLECTE HORAIRE POUR TRAITEMENT DE RESEAU SUR ORDINATEUR UTILISE POUR LA MODELISATION ET LA PREVISION DE L'HYDRAULICITE).
Electricite de France, Grenoble. Div. Technique.
For primary bibliographic entry see Field 7A.
W91-12421

LIMESTONE GENERATING STATION PROVIDES POWER FOR MANITOBA.
Manitoba Hydro, Winnipeg.
R. Lovering, L. F. Hiley, and D. Windsor.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 7, p 17-20,22, July 1991. 2 fig.

Descriptors: *Hydroelectric plants, *Limestone Generating Station, *Manitoba, *Nelson River, *Water resources development, Canada, Cold weather construction, Cost analysis, Energy sources, Hydroelectric power.

Having developed the full power potential of the Winnipeg River system in southern Manitoba, and built the Grand Rapids generating station on the Saskatchewan River in the western part of the province, it was logical for Manitoba Hydro to look northwards towards the Nelson River. The

Nelson River basin is one of the major drainage areas of North America, covering an area of more than 1 million square kilometers. The 1280 MW Limestone generating station has been developed as the fifth and largest generating station that Manitoba Hydro has built on the Nelson River and the third on the lower arm of the Nelson River. Limestone is a run-of-river project, which makes the most efficient use of the natural elements of the river. It has so far been constructed slightly ahead of schedule and well below budget. The final cost of the project is currently estimated at $1.25 billion. One of the factors resulting in lower costs was the combination of lower interest rates and lower escalation costs than anticipated. By September 1990, the first unit began producing power and all 10 units should be operating by 1992. Among the unusual challenges of the Nelson project are the extreme cold during winter, which requires special construction procedures to be used, and the severe ice jam formation caused by the development of frazil ice, which forms natural dams that result in upstream-migrating river stages. Besides helping to meet the electricity needs of Manitoba, the Nelson generating station will export power to Ontario and Saskatchewan, as well as to the United States. (Rochester-PTT)
W91-12441

DIAMOND WIRE SAWING ACCELERATES DAM REHABILITATION SCHEME.
Cutting Technologies International, Cincinnati, OH.
T. R. Beckman, and R. M. Hulick.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 7, p 25-28, July 1991. 6 fig.

Descriptors: *Concrete dams, *Diamond wire saws, *Hudson River, *Maintenance, *Rehabilitation, Cold weather construction, Concrete repair, Construction methods, Hydroelectric plants, New York.

Diamond wire saws, originally developed to modernize quarry operations, are finding many applications in major construction projects. The rehabilitation of the Sherman Island hydro development, which is on the Hudson River near Glens Falls, New York, took advantage of this technique. The dam, an amberson (hollow arch concrete) design, had become damaged by a combination of chemical reaction and freeze-thaw action caused by seasonal weather changes. A smooth-cutting diamond wire saw was used to remove large sections of deteriorated concrete without disturbing the structural integrity of the remainder of the dam. The wire saw consists of a rotating wheel, generally 400 to 1200 mm in diameter, with a rubber-line V-groove to grab. The wire saw/drive wheel is rotated by a direct-drive motor, generally hydraulic for construction use. The wire saw consists of a wire rope core with a steel jacket, typically with 32-42 steel, diamond-bearing beads per meter. Using this device, smooth, vibration-free cuts have been made through large sections, even with difficult access and in sub-freezing temperatures. The diamond wire cutting technology also eliminates the problems of dust and noise associated with conventional concrete removal techniques. (Rochester-PTT)
W91-12442

DESIGN EVOLUTION OF THE MOUNT HOPE WATERPOWER PROJECT.
Mount Hope Waterpower Project, Dover, NJ.
For primary bibliographic entry see Field 8A.
W91-12444

CRITICAL SUBMERGENCE IN TWO-LAYER STRATIFIED FLOW.
Memorial Univ. of Newfoundland, St. John's. Faculty of Engineering and Applied Science.
For primary bibliographic entry see Field 8B.
W91-12565

REPLACEMENT OF MITER GATES WHEN RECONSTRUCTING NAVIGATION LOCKS.
V. Y. Martenson.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 500-503, 1991. 2 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 15-17, August 1990.

Descriptors: *Gates, *Hydraulic gates, *Hydraulic structures, *Locks, *Moscow Canal, *Navigation canals, *Structural engineering, Fatigue.

The Moscow Canal, originally put into operation in June 1937, has provided the connecting link of a single deep-water navigation system and is the only reliable source of water supply for the city. The canal, even by current standards, is an extremely intricate hydrotechnical complex consisting of dams, hydroelectric stations, pumping stations, navigation locks, and other hydraulic structures. Due to the intense use of the canal locks over time, the mechanical equipment such as the gates and miter gates are wearing out. Inspection reports of lock gates and valves revealed metal corrosion of 4 to 6 mm in some places which will cause some degree of metal fatigue. Cracks caused by fatigue will likely occur in places under maximum stress and can lead to the destruction of the bearing elements in the framework of the gates or valves. After reviewing the inspection reports, the commission unanimously concluded that locks must be reconstructed and miter gates replaced. Though costly and complex, the repair work is considered more economically beneficial than later total reconstruction costs if the structure fails. As this repair work is extremely complex to implement, several elements of the construction work are discussed. Confounding the complexity of the necessary repairs, the repair work needs to be completed during winter months after the navigation season is over. Current technology indicates that the use of a heavy-freight floating crane would be cost-effective in replacing the mechanical equipment. (Collins-PTT)
W91-12613

ROLLCRETE UPSTREAM WING WALL.
For primary bibliographic entry see Field 8F.
W91-12615

EXPERIENCE IN OPERATING THE WATER-COOLING SYSTEMS OF THE GENERATOR STATOR WINDINGS AT THE INGURI HYDROELECTRIC STATION.
D. G. Tskhvirashvili, Z. D. Berishvili, V. G. Keshelava, Y. A. Tsagareli, and G. S. Mikava.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 521-524, 1991. 4 fig, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 29-31, August 1990.

Descriptors: *Ammonia, *Cooling water, *Electrical equipment, *Hydroelectric plants, *Hydrogen ion concentration, *Industrial water, *Maintenance, *Water treatment, Copper, Distilled water, Inguri, Soviet Union.

The hydroelectric generators installed at the Inguri hydroelectric station utilize intraconductor water cooling of the stator. The stator winding has 432 bars in which there are 10 hollow insulated copper conductors that allow the passage of water. The stator windings are cooled by means of a closed loop: drain header, surge tank, circulation pump, ion-exchange filter of mixed action (FMA), water-water heat exchanger, mechanical filter, delivery header, group of bars, and drain header. The desalinized cooling water is periodically passed through the FMA to correct its composition. Since 1980, the cooling water has been treated with ammonia and benzotriazole in all generators at the Inguri hydrostations. The ammonia-benzotriazole water regime (ABWR) has proven to be a reliable method and has shown no decrease in the operating efficiency. The ABWR does not require mandatory deaeration of the additional distilled water or the use of nitrogen protection of the cooling system from air. The protective properties of the ABWR far surpass earlier methods due to the formation of natural oxide films of nearly insoluble copper compounds which decreases the need for cleaning to once in every 7 to 8 years. The main criterion for operating the ABWR is regulation of the pH by adding ammonia to the distilled water. The optimal pH ranges from 6.8 to 7.7. Optimal management of the ABWR requires adherence to a specific order of feeding the ammonia and benzotriazole into the distilled water on a regular basis every 20 to 30 days. This procedure should not be discontinued for more than 2 months. The ABWR is simple to use, inexpensive, and highly reliable, surpassing all known methods of treating distilled water in a generator water-cooling system. (Collins-PTT)
W91-12618

SEEPAGE REGIME IN THE FOUNDATION OF THE SAYANO-SHUSHENSKOE HYDROELECTRIC STATION DAM DURING STAGED FILLING OF THE RESERVOIR.
For primary bibliographic entry see Field 8A.
W91-12619

SOME WAYS TO IMPROVE THE NATIONAL ECONOMIC EFFICIENCY OF HYDROPOWER ENGINEERING.
For primary bibliographic entry see Field 6C.
W91-12620

CAPANDA HYDRO DEVELOPMENT IN ANGOLA.
V. E. Fedosov.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 537-542, 1991. 3 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 40-43, August 1990.

Descriptors: *Capanda Hydroelectric Project, *Climatic data, *Concrete dams, *Dam design, *Geological data, *Gravity dams, *Hydroelectric plants, Angola, Dam construction, Electrical equipment, Grouting, Model studies, Turbines.

Construction of the main structures of the Capanda hydro development on the Cuanza River in Angola, located 380 kilometers east of the capital Luanda, began in 1987. Its primary purpose is to supply power--with a capacity of 520,000 kilowatts and ability to produce 3 billion kilowatts of energy per year. A 1.2 km long, 110 m high, concrete gravity dam is being constructed across the Cuanza River. The design calls for the foundation of the dam to be constructed with watertight curtain grouting, consolidation grouting, and drainage. The geology and climatology characteristics are reviewed in relation to the site permeability and runoff rates, respectively. Specifications for the turbines, generators, and power transformers are presented. Hydraulic studies were preformed to determine design specifications of the diversion tunnel, the dam, and the prevention of cavitation erosion. Data from the model investigations by the electrical analogy method revealed the seepage pattern of the rock mass behind the dam and allowed determination of the necessary drainage measures. Stress-strain investigations of the body and foundation of the dam in two-dimensional and three-dimensional formulations substantiated the design profile of the dam. (Collins-PTT)
W91-12622

DETACHABLE FISHWAY FOR STEEP CULVERTS.
Montana Dept. of Fish, Wildlife and Parks, Hamilton.
For primary bibliographic entry see Field 8I.
W91-12894

8D. Soil Mechanics

RADAR SYSTEM FOR MAPPING INTERNAL EROSION IN EMBANKMENT DAMS.
Sveriges Geologiska Undersoekning, Uppsala.
P. M. Andersson, B. G. Linder, and N. R. Nilsson.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 7, p 11-16, July 1991. 9 fig, 6 ref.

Descriptors: *Dam inspection, *Dam stability, *Earth dams, *Measuring instruments, *Radar, *Remote sensing, Erosion, Geologic erosion, Sinkholes, Subsurface mapping, Sweden.

The RAMAC borehole radar system is a remote sensing technique that has been applied in remote fracture detection, cavity detection, mineral exploration, structural geological mapping, and hydrogeological investigations. Because of satisfactory performance in these applications, a development project was conducted to use the RAMAC borehole radar system for mapping the conditions within the core of an embankment dam. Radar measurements were taken around a sinkhole, probably caused by internal erosion, in the Suorva hydropower dam. The results were good and were consistent throughout the investigated volume. The interpreted result yielded a radar model of areas with increased and anomalous porosity. The radar model result was partly supported by results from geological mapping on core samples, as well as by results from the subsequent grouting program in the investigated area. (Rochester-PTT)
W91-12440

CALCULATIONS OF THE STRESS-STRAIN STATE OF THE CENTRAL ZONE OF BLAST-FORMED DAMS.
For primary bibliographic entry see Field 8H.
W91-12616

8E. Rock Mechanics and Geology

ENGINEERING-GEOLOGICAL CONDITIONS IN THE REGION OF THE CAPANDA HYDRO DEVELOPMENT.
I. F. Karyakin.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 543-548, 1991. 1 fig, 2 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 44-48, August 1990.

Descriptors: *Capanda Hydroelectric Project, *Concrete dams, *Engineering geology, *Geologic formations, *Gravity dams, *Hydroelectric plants, Angola, Geohydrology, Geomorphology, Sandstones.

The Capanda hydro development, with a design capacity of 520 megawatts, is located in the middle course of the Cuanza River in the central part of Angola in the province of Malanje. The main structures of the hydro development include: a concrete gravity dam with a spillway in the channel part and bottom outlet at a normal pool level of 950 meters; a powerhouse complex consisting of the headrace canal of the hydroelectric station, water intake, tunnel penstocks, powerhouse, and tailrace canal; and outdoor switchgear. The engineering-geological conditions of the Capanda hydro development are determined by a set of natural characteristics of the region, the most important of which are the geological structure, geomorphological characteristics, hydrogeological conditions, and the composition and properties of the rocks. The hydro development is located within one tectonically-monolithic block with a subhorizontal occurrence of the rocks without large tectonic disturbances. The rock formations consist of hard, dense, fractured arkosic sandstones and conglomerates. The dam site is located in a canyon-shaped valley and the reservoir zone in a primarily U-shaped valley. The hydrogeology is controlled by fissure-type subsurface water with infiltration recharge and discharge into the river valley. The waters are slightly mineralized (up to 0.3 grams/liter) but are not corrosive to concrete. The rocks at the base of the dam structures have high indices of physical and mechanical properties and low permeability. Sufficient local building materials are available to construct the hydro development complex. On a whole, the engineering-geological conditions for the construction of the Capanda hydro development are favorable. (Collins-PTT)
W91-12623

8F. Concrete

LEAKAGE FROM TWO CONCRETE MANURE TANKS.
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W91-11650

EVALUATION OF THE POTENTIAL ALKALI-REACTIVITY OF CONCRETE AGGREGATES PRODUCED IN THE ST. LAWRENCE LOWLANDS OF QUEBEC (CANADA) (EVALUATION DU POTENTIEL DE REACTIVITE ALCALINE DES GRANULATS A BETON PRODUITS DANS LES BASSES-TERRES DU SAINT-LAURENT DU QUEBEC (CANADA)).
Canada Centre for Mineral and Energy Technology, Ottawa (Ontario).
B. Fournier, and M. A. Berube.
Canadian Journal of Civil Engineering CJCEB8, Vol. 18, No. 2, p 282-296, April 1991. 13 fig, 3 tab, 59 ref. English summary.

Descriptors: *Canada, *Concrete testing, *Concretes, *Rock properties, Bases, Expansion, Laboratory methods, Sedimentary rocks, St Lawrence Lowlands.

Seventy-one samples of aggregates representing the various sedimentary rocks exploited in the St. Lawrence Lowlands (Canada) were submitted to standard and experimental laboratory tests to evaluate their potential alkali-reactivity in concrete. Among these, only the Trenton and Black River limestones with more than 6% insoluble residues produced excessive expansion in the concrete prism test, the most reliable method for assessing the alkali-reactivity potential of concrete aggregates. Expansion values of 0.1 and 0.15%, obtained respectively after 14 days in the accelerated mortar bar test (1 M NaOH at 80 C) and 5 hr of autoclave curing (0.17 MPa at 130 C and 100% relative humidity), can be used only as acceptance limits, since nonexpansive aggregates (as per the concrete prism test) from the Black River, Chazy and Beekmantown Groups induced excessive expansion in these tests. Limiting the reactive alkali content of the concrete mix to 3 kg/cu m or using cements containing between 5 and 10% of condensed silica fume can reduce the risks of deleterious reactions associated with the siliceous limestone aggregates produced in the St. Lawrence Lowlands. (Author's abstract)
W91-12087

KOLNBREIN DAM: AN UNUSUAL SOLUTION FOR AN UNUSUAL PROBLEM.
For primary bibliographic entry see Field 8A.
W91-12196

DIAMOND WIRE SAWING ACCELERATES DAM REHABILITATION SCHEME.
Cutting Technologies International, Cincinnati, OH.
For primary bibliographic entry see Field 8C.
W91-12442

INVESTIGATION OF PROBLEMS OF CONSTRUCTING THE KHUDONI ARCH DAM BY THE CONTINUOUS CONVEYOR TECHNOLOGY.
For primary bibliographic entry see Field 8A.
W91-12612

ROLLCRETE UPSTREAM WING WALL.
V. B. Sudakov, V. S. Shangin, S. M. Ginzburg, M. A. Karteleva, and A. I. Klebanov.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 509-515, 1991. 5 fig, 2 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 21-25, August 1990.

Descriptors: *Concrete dams, *Concrete mixes, *Design criteria, *Gravity dams, *Hydraulic engineering, *Hydroelectric plants, Concrete testing, Dam construction, Soviet Union, Testing procedures.

A rollcrete upstream wing wall was constructed as part of the Tashkumyr hydro development. Together with the upstream earth cofferdam, the wing wall separates the pit of the left bank dam from the basin of the powerhouse and forms the barrier for starting up the first phase of the hydroelectric station. Structurally, the wing wall acts as a gravity dam and its design specifications are presented. Cores were drilled in the wall after its installation to estimate the strength and density of the rollcrete. The tests indicate that the rollcrete wing wall has held up satisfactorily over its past three years in operation. The tests also show that the nonuniformity or density anisotropy of the rollcrete must be considered during the design phase. Particularly, the horizontal joints have a high permeability which requires either a special technology while forming them or structural protection of the masonry using vibrated concrete. For temporary dams, a gunite layer may protect the masonry. A uniform temperature regime with low maximum temperatures is characteristic of rollcrete. Furthermore, measured temperatures of the wall masonry corresponded to those calculated and consequently, the possibility of predicting the temperature regime of the rollcrete during its construction is verified. Overall, the upstream wing wall at the Tashkumyr hydroelectric station confirmed the possibility and expediency of using lean rollcrete in simple designs for dams. (Collins-PTT)
W91-12615

CONSTRUCTION OF COMPACTED ASPHALTIC CONCRETE CORE WALLS OF EARTH DAMS.
For primary bibliographic entry see Field 8A.
W91-12617

8G. Materials

TEXTURED GEOMEMBRANE FOR THE STAGED RAISING OF CERRO DO LOBO DAM.
Knight, Piesold and Partners, Ashford (England).
M. Cambridge, and E. Maranha de Neves.
International Water Power and Dam Construction IWPCDM, Vol. 43, No. 6, p 57-58, 61, 63-64, June 1991. 8 fig, 3 ref.

Descriptors: *Geotextiles, *Industrial water, *Portugal, *Rockfill dams, *Waste storage, Civil engineering, Cost analysis, Dam construction, Mine wastes, Neves Corvo Mine.

The development of the mine at Neves Corvo, southern Portugal, has necessitated the staged construction of a 39 m-high embankment dam for the storage of processed waste (tailings) and for industrial water supply. the first-phase storage facility comprised a conventional clay-cored rockfill dam, constructed in 1988 from mine waste rockfill and locally won clay. During the second phase, the shortage of suitable clay necessitated the construction of the subsequent stages of the dam using a geomembrane. This extension of the dam has involved the installation of a textured HDPE membrane and the design of anchorage connections, both within the existing clay core and the foundations at the abutments. In parallel with the design process, laboratory testing was conducted to define the geotechnical characteristics of the various materials. The values of the peak effective friction angle for the textured geomembrane were in the range 42-44 deg. A sand-bentonite mixture for the stage 1 core of the dam was also tested. Permeability values were below the target value of 10 to the -8th power m/sec, and the sand-bentonite mixture was thus considered satisfactory as a sealant for the anchorage trench. Both the sand-bentonite mixture and the geomembrane were manufactured near the construction site. The adoption of a textured geomembrane at Neves Corvo allowed rapid and economical construction of the dam to its interim design height and will enable future construction stages to be achieved with comparative ease and at an economical cost. (Rochester-PTT)
W91-12199

RADAR SYSTEM FOR MAPPING INTERNAL EROSION IN EMBANKMENT DAMS.
Sveriges Geologiska Undersoekning, Uppsala.

For primary bibliographic entry see Field 8D.
W91-12440

DESIGN AND USE OF INTEGRATING HEADER PITOT GRIDS.
For primary bibliographic entry see Field 8B.
W91-12610

CATHODIC PROTECTION OF THE PENSTOCKS OF THE MINGECHAUR HYDROELECTRIC STATION.
Y. Z. Shikhaliev.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 504-509, 1991. 6 fig, 3 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 18-20, August 1990.

Descriptors: *Anodes, *Corrosion control, *Hydraulic engineering, *Hydroelectric plants, *Penstocks, *Protection, Intakes, Soviet Union, Steel.

Corrosion protection of steel elements in a freshwater flow system is a complex problem in hydrotechnical construction. Tests conducted on the inside surfaces of penstocks, components of water intakes, at the Mingechaur hydrostation revealed considerable corrosion. High dissolved oxygen in water, low hardness, high activity by pH, and biofouling contribute to the corrosion. The results of several cathodic protection tests are presented. The data indicate that corrosion may be prevented cathodically by installing a continuous anode along the axis of the penstock cylinder. (Collins-PTT)
W91-12614

8H. Rapid Excavation

CALCULATIONS OF THE STRESS-STRAIN STATE OF THE CENTRAL ZONE OF BLAST-FORMED DAMS.
M. V. Suslova.
Hydrotechnical Construction HYCOAR, Vol. 24, No. 8, p 515-517, 1991. 3 fig, 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 25-26, August 1990.

Descriptors: *Dam construction, *Earth dams, *Explosions, *Finite element method, *Model studies, *Rapid excavation, *Soil properties, *Strain, *Stress analysis, Density, Structural engineering.

Using the finite-element method in viscoelastic and viscoplastic formulations, the stress-strain state of blast-formed dams was calculated. The mathematical soil model takes into account the nonlinearity of its properties. Calculations for dams created by an excavating explosion were carried out under the assumption that the dam is formed by various-sized columns of soil falling from different heights. The maximum vertical stresses after impact occur at the base of the soil mass. The calculations show that the height at which the soil is dropped determines the initial velocity of the point of mass and affects the formation of the stress-strain state. The value of maximum stress will be greater when the initial velocity of points of soil is greater. The greater the drop height, the sooner the maximum stress value is reached. Density calculations over the height of the soil column showed that the greater the drop height, the greater the soil density after stabilization of deformations. Also, the greater the drop height, the more the density distribution over the height of the dam differs from linear. An initial velocity exists at which a maximum density of soil will be obtained in the lower part of the dam. If the drop height is increased, the density increases only in the upper part of the dam. (Collins-PTT)
W91-12616

8I. Fisheries Engineering

BIOLOGICAL OBSERVATIONS ON FRESHWATER SYSTEMS ADJACENT TO THE COAST OF SIERRA LEONE.
Ministry of Agriculture, Natural Resources and Forestry, Freetown (Sierra Leone). Fisheries Div.
For primary bibliographic entry see Field 2H.
W91-11627

INTENSIVE PRODUCTION OF OREOCHROMIS MOSSAMBICUS (PETERS) WITH SPECIAL REFERENCE TO THE RELATIONSHIP BETWEEN WATER EXCHANGE RATE AND GROWTH RATE.
Zululand Univ., Empangeni (South Africa).
J. G. J. Visser.
Water SA WASADV, Vol. 17, No. 2, p 139-146, April 1991. 5 fig, 4 tab, 14 ref.

Descriptors: *Fish farming, *Tilapia, *Water requirements, *Water use, Ammonia, Dissolved oxygen, Growth, Hydrogen ion concentration, Temperature, Turbidity, Waste removal.

Tilapia is an important species of finfish for culturing because of the increasing demand for fish protein. Therefore, a study was conducted to determine the relationship between growth (production) and water used. The experiments were carried out over a period of three production seasons of 200 d each. Most of the waste food and feces which accumulated at the central drain were flushed out by draining a known volume of water from the tank each day. Residual waste was removed by regular sweeping of the floor during drainage. Regular recordings were made of minimum and maximum temperatures, pH, turbidity, dissolved oxygen, rainfall, and ammonia. A significant positive correlation existed between production and water used in the four ponds stocked with monosex O. mossambicus. A certain minimum volume of water appears to be needed to remove growth-inhibiting metabolites and other wastes from the production system. This relationship will be dependent on size, different sexes and densities used. It is therefore necessary to determine the relationship experimentally for each system before commercial application, especially in regions where water is a scarce resource. (White-Reimer-PTT)
W91-11769

SCREENING AS A METHOD FOR REMOVAL OF PARASITES FROM INLET WATER TO FISH FARMS.
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5F.
W91-12411

FISHES IN THE FORESTED FLOOD PLAIN OF THE OCHLOCKONEE RIVER, FLORIDA, DURING FLOOD AND DROUGHT CONDITIONS.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2H.
W91-12663

FISH COMMUNITY STRUCTURE IN DRY-SEASON STREAM POOLS.
East Texas State Univ., Commerce. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W91-12807

MORTALITY OF JUVENILE CLUPEIDS DURING PASSAGE THROUGH A TIDAL, LOW-HEAD HYDROELECTRIC TURBINE AT ANNAPOLIS ROYAL, NOVA SCOTIA.
Acadia Univ., Wolfville (Nova Scotia). Dept. of Biology.
K. D. E. Stockesbury, and M. J. Dadswell.
North American Journal of Fisheries Management NAJMDP, Vol. 11, No. 2, p 149-154, Spring 1991. 3 fig, 3 tab, 21 ref.

Descriptors: *Annapolis River, *Ecological effects, *Fish passages, *Herring, *Hydroelectric powerplants, *Mortality, *Tidal powerplants, Fish ladders, Fisheries, Fishkill, Juvenile growth stage, Nova Scotia, Turbines, Water resources development.

Migrant juvenile clupeids passing through the tidal, low-head hydroelectric turbine at Annapolis River, Nova Scotia, were monitored during the fall of 1985 and 1986. Although there were two fishways adjacent to both sides of the turbine intake, 98% of the clupeids passed through the tidal-power turbine. Total mortality of clupeids from turbine passage was estimated to be 46.3% for both years combined. Injuries observed were attributed to pressure effects (64.5%), mechanical strike (33.9%), and hydraulic shearing (1.7%). (Author's abstract)
W91-12827

INCLINED-SCREEN SMOLT TRAP WITH ADJUSTABLE SCREEN FOR HIGHLY VARIABLE FLOWS.
Wisconsin Dept. of Natural Resources, Brule.
R. B. DuBois, J. E. Miller, and S. D. Plaster.
North American Journal of Fisheries Management NAJMDP, Vol. 11, No. 2, p 155-159, Spring 1991. 3 fig, 20 ref. Anadromous Fish Conservation Act (Project WI-AFS-16) and the Federal Aid in Fish Restoration Act (Project F-83-R).

Descriptors: *Bois Brule River, *Fish management, *Sampling, *Smolt, *Stream fisheries, *Trapping, Case studies, Design standards, Fisheries, Flow profiles, Flow velocity, Hydraulic structures, Salmon, Trout, Water level, Wisconsin.

An inexpensive inclined-screen smolt trap was designed and constructed for use in rivers having highly variable flow regimes. The trap included a pontoon-supported floating catch barge and an adjustable inclined screen made of parallel aluminum rods that effectively strained large volumes of water, transported smolts without injury, and was highly resistant to debris buildup and easily cleaned. The inclined screen was supported by a movable carriage within a stationary frame that permitted the screen to be deployed at a wide range of depths and angles depending on flow conditions and amount of waterborne debris. The trap was operated for three field seasons in the Bois Brule River, a large Wisconsin tributary to western Lake Superior, to capture and retain parr and smolts of steelhead Oncorhynchus mykiss, coho salmon O. kisutch, chinook salmon O. tshawytscha, and brown trout Salmo trutta, ranging from 45 to 300 mm in total length. The trap remained operational in flows ranging from 2.1 to 17.3 cu m/sec and through large variations in debris content without sustaining damage or requiring excessive maintenance. The design could be adapted to most locations where a low-head dam exists or can be established. (Author's abstract)
W91-12828

RELATIONS AMONG STREAM TEMPERATURE, ANGLING SUCCESS FOR RAINBOW TROUT AND BROWN TROUT, AND FISHERMAN SATISFACTION.
Montana State Univ., Bozeman. Dept. of Biology.
G. A. McMichael, and C. M. Kaya.
North American Journal of Fisheries Management NAJMDP, Vol. 11, No. 2, p 190-199, Spring 1991. 4 fig, 7 tab, 19 ref.

Descriptors: *Madison River, *Sport fishing, *Stream fisheries, *Trout, *Water temperature, Fish populations, Fishing, Montana, Recreation.

On-site creel surveys were conducted in 1987 and 1988 while water temperature was continuously recorded on two sections--an upper, cooler section and a lower, warmer section--of the Madison River in Montana. Results from 1,741 angler contacts showed that as fishing temperatures increased catch rates for trout (rainbow trout and brown trout combined) tended to decline in both sections. In the warmer, lower section, average catch rates declined to levels considered unsatisfactory by anglers in that section (</= 0.4-0.6 trout/hr) at temperatures of 19 C or higher. In the cooler, upper section, fishing temperature seldom exceeded 19 C, and average catch rates generally remained above levels considered unsatisfactory (0.6-0.7 trout/hr) by anglers in that section. At similar temperatures, catch rates were generally higher in the upper section. The percentage of anglers catching no trout increased significantly with increasing

temperature in the lower section, to 50% or more at temperatures above 19 C. The results indicate that angling quality for brown and rainbow trout is impaired at temperatures considerably below the upper lethal limits for these species. (Author's abstract)
W91-12830

SEASONAL MIGRATION OF SMALLMOUTH BASS IN THE EMBARRASS AND WOLF RIVERS, WISCONSIN.
Wisconsin Dept. of Natural Resources, Shawano.
For primary bibliographic entry see Field 2E.
W91-12893

DETACHABLE FISHWAY FOR STEEP CULVERTS.
Montana Dept. of Fish, Wildlife and Parks, Hamilton.
C. G. Clancy, and D. R. Reichmuth.
North American Journal of Fisheries Management NAJMDP, Vol. 10, No. 2, p 244-246, Spring 1990. 2 fig, 1 tab, 4 ref.

Descriptors: *Culverts, *Fish ladders, *Fish migration, Hydraulic structures, Spawning, Trout.

A fishway constructed of angle iron and reinforcing bars was installed in a high gradient culvert along the Yellowstone River, to allow the passage of Yellowstone cutthroat trout (Oncorhynchus clarki bouvieri) to upstream spawning areas. The structure was detachable from the culvert, inexpensive, and portable. Recent investigations have revealed that the fishway is still effective 8 years after installation. (Author's abstract)
W91-12894

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

COOPERATIVE ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY WITH HISTORICALLY BLACK COLLEGES AND UNIVERSITIES, FISCAL YEARS 1983-90.
Geological Survey, Reston, VA. Water Resources Div.
A. E. Hall, and J. C. Scott.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-93, 1991. 36p, 5 fig, 3 tab.

Descriptors: *Education, *Employment, *Interagency cooperation, Historically Black Colleges and Universitities, Training.

The U.S. Department of the Interior, U.S. Geological Survey, has been involved in numerous cooperative activities with Historically Black Colleges and Universities. Assistance agreements, which include both grants and cooperative agreements, have fostered many educational research and development activities. These activities have included site visits, employment opportunities, curriculum development, seminars, and research projects. The activities are consistent with the Geological Survey's mission of conducting earth-science research and dissemination of the results. The cooperative programs have benefitted the Historically Black Colleges and Universities, their students, and the Geological Survey. (USGS)
W91-11929

9D. Grants, Contracts, and Research Act Allotments

FISCAL YEAR 1989 PROGRAM REPORT (HAWAII WATER RESOURCES RESEARCH CENTER).
Hawaii Univ., Honolulu. Water Resources Research Center.
L S. Lau.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-159426. Price codes: A03 in paper copy, A01 in microfiche. Program Report G-1558-02. October 1990. 35p, 31 ref. USGS Contract No. 14-08-0001-G1558. USGS Project No. G1558-02.

Descriptors: *Hawaii, *Information transfer, *Research, *Training, *Water resources Institutes, Education, Projects.

This report summarizes the activities of a small but special program in research and information transfer funded by the U.S. Geological Survey for the period 1 August 1989 to 31 July 1990. Six research projects were conducted: five addressing droughts, toxic chemicals, evaporation, water rights, and taro (crop) water requirement, all problems and issues in Hawaii; and one addressing water-related economics in Saipan, capital of the Commonwealth of the Northern Mariana Islands. A Hawaii water research agenda for the 1990's was formulated with major input from the second WRRC conference. The long-standing WRRC Seminar Series was conducted with 10 seminars in Fall 1989 and 15 seminars in Spring 1990. (Lau-HA Univ., WRRC)
W91-11872

FISCAL YEAR 1989 PROGRAM REPORT (NEW MEXICO WATER RESOURCES RESEARCH INSTITUTE).
New Mexico Water Resources Research Inst., Las Cruces.
T. G. Bahr.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-159434. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1578-01, July 1989. 33p. USGS Contract No. 14-08-0001-G1578. USGS Project G1578-01.

Descriptors: *Information transfer, *New Mexico, *Research, *Training, *Water resources Institutes, Education, Projects.

The New Mexico Water Resources Research Institute's (WRRI) goal is to maintain a balanced research program that addresses water problems critical to New Mexico, the Southwest, and the nation. Within the USGS portion of the institute's program, three major water problem priority areas were addressed: (1) water conservation, primarily directed toward research to develop water conserving agricultural crops; (2) surface/groundwater relationships, particularly recharge; and (3) water quality, focusing on protecting water from impairment. The institute's USGS program supported one project in the first priority area: a project involving the study of uncommon polyamines involved in plant water-use efficiency and tolerance to water deficit and heat stresses. Four projects addressed the second area: a project concerning the quantification of seepage from ephemeral streams and prediction of the response in the aquifer; a project that re-examines current groundwater management policies in the state; a project to determine if current lightning location systems can be used to give useful quantitative estimates of precipitation volume and runoff water; and a project that will evaluate and predict three-dimensional permeability anisotropy. The third priority area was addressed by three projects: one project providing quantitative data on the effects of water flow rate, water application method, and the degree of preferential water flow; a project designed to evaluate the feasibility of using a new technology to provide extensive treatment of septic tank effluent; and another project which will continue to test a new method for evaluating permeability distribution. (Klett-NM WRRI)
W91-11879

FISCAL YEAR 1989 PROGRAM REPORT (NEBRASKA WATER CENTER).
Nebraska Univ., Lincoln. Water Resources Center.
B. G. Volk.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-168955. Price codes: A03 in paper copy, A01 in microfiche. Report No. G-1574, December 1990. 28p. USGS Contract No. 14-08-0001-G1574.

Descriptors: *Information transfer, *Nebraska, *Research, *Training, *Water resources Institutes, Education, Projects.

Research programs supported in part by the Water Resources Research Act of 1984, USGS 104 program for 1989, addressed critical water quality and quantity issues in Nebraska. Projects ranged from irrigation technology, pore size assessment, decision making techniques, to in-situ bio-denitification. Project 02 is developing a systems approach for detection, mapping, monitoring, and remediation of contaminated aquifers. This research focuses on multi-criteria decision making techniques. Project 03 is studying pore size distribution and redistribution of agrichemicals in the soil profile. Results imply the macropores may not be as important to atrazine transport in the drier soils of the U.S. as they are reported to be in the more humid regions of the country. Project 04 deals with the potential for irrigation and nitrogen fertilizer management to reduce groundwater quality degradation. Specific research objectives were to develop field techniques to monitor soil water movement on a year-around basis and to measure the quantity and quality of leachate below irrigated crops. Project 05 objectives are centered on an assessment of the potential applicability of in-situ biodenitrification and investigation of factors controlling the process that can be used in its enhancement. Project 06 is quantifying the infiltration parameters under both surge irrigation and irrigation following furrow packing in comparison to conventional irrigation practices. (USGS)
W91-11911

FISCAL YEAR 1989 PROGRAM REPORT (MONTANA WATER RESOURCES CENTER).
Montana State Univ., Bozeman. Water Resources Research Center.
H. S. Peavy.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-168948. Price codes: A03 in paper copy, A01 in microfiche. Annual Program Report No. G1573-01. 31p. USGS Contract No. 14-08-0001-G1573. USGS Project No. G1573-01.

Descriptors: *Information transfer, *Montana, *Research, *Training, *Water resources Institutes, Education, Projects.

The program summarized in this report included research that concluded the following: (1) equations used to determine the flow rate to strip-pit mines are adequate provided data points are taken sufficiently close to the pit. There appears to be no correlation between the flow rate and the quality of the water flowing to the pit; (2) models that predict flow of leachate from landfills are being examined for applications in arid and semi-arid areas; (3) the level of recreational use of streams appears to be positively and significantly correlated to the level of instream flow. On an annual basis, the average value for fishing varied from around $20/acre-ft on smaller rivers to only a few cents/acre-ft on the largest rivers in the state. During high-use summer periods, these values rose to a range of from $33 to $65/acre-ft on the smaller streams; (4) streambank erosion and cattle use of seeps and bogs immediately adjacent to the stream are the principal sources of instream sediment loads from range lands. Most sediment produced in upland areas can be intercepted by well-vegetated riparian zones; (5) modelling can be an effective means for determining key variables in in-situ bioremediation programs and, thus, for designing more efficient treatment systems. Appropriate computer models can be used to minimize the amount of laboratory and pilot studies required for assessing the potential for using in-situ bioremediation; (6) in addition to the above research, the program included information transfer and educational components to increase the awareness and knowledge of the water user/manager community and the general public. Grants of approximately $154,000 were secured from several public and private entities to initiate and support public education programs. (USGS)
W91-11912

FISCAL YEAR 1989 PROGRAM REPORT (COLORADO WATER RESOURCES RESEARCH INSTITUTE).
Colorado State Univ., Fort Collins. Water Resources Lab.
N. S. Grigg.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-168930. Price codes: A03 in paper copy, A01 in microfiche. Annual Report No. 26, Program Report G1511-01, August 1990. 45p. USGS Contract No. 14-08-0001-G1511. USGS Project No. G1511-01.

Descriptors: *Colorado, *Information transfer, *Research, *Training, *Water resources Institutes, Education, Projects.

This 26th annual report describes the Institute's progress in research and technology development on priority problems which confront Colorado's water managers. The FY1989 Program included the following research priorities: Project 02: Screening Methods for Groundwater Pollution Potential From Pesticide Use in Colorado Agriculture; Project 03: Field Demonstration of Biological Denitrification of Polluted Groundwater; Project 04: Adsorption of Copper, Cadmium and Zinc on Suspended Sediments in a Stream Contaminated by Acid Mine Drainage: The Effect of Seasonal Changes on Dissolved Organic Carbon; Project 05: Enhanced Microbial Reclamation of Groundwater Polluted with Toxic Organic Chemicals; Project 06: Potential Role of the South Platte Tributary Aquifer in Solving Front Range Drought Water Supply Problems; Project 07: Hydrologic Aspects of Revegetation Following Water Transfers from Irrigated Farmland; Project 08: Investigation of a Three-Dimensional Stream-Aquifer Model as a Support Tool for Conjunctive Management; Project 10: Improving Streamflow Forecasts for Colorado River Systems; Project 11: Development and Laboratory Verification of Models of Surface-Subsurface Water Quality Interaction; and Project 12: Response of Groundwater Faunas to Groundwater Quality Degradation. This report also describes the Institute's technology transfer program and other research funded by its state appropriation. (USGS)
W91-11913

FISCAL YEAR 1989 PROGRAM REPORT (SOUTH DAKOTA WATER RESOURCES INSTITUTE).
South Dakota State Univ., Brookings. Water Resources Inst.
A. R. Bender.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-168922. Price codes: A03 in paper copy, A01 in microfiche. Program Report, 1990. 37p. USGS Contract No. 14-08-0001-G1590. USGS Project No. G1590-01.

Descriptors: *Information transfer, *Research, *South Dakota, *Training, *Water resources Institutes, Education, Projects.

Development of agricultural water use and the maintenance of adequate and safe water supplies for industrial and domestic use are high priority issues in South Dakota. The FY89 SWRIP supported five research projects ranging from the scientific principals of total water management and groundwater protection to the authority and governance of local administrative districts. Total water management considers the complex interactions of vegetative growth, agricultural management, soil chemical and physical properties, storage and movement of soil water, and the effects of those interactions on surface and groundwater quality, while the districts are necessary to implement policy at the ground level. The Institute information transfer is dialogue based and provides usable information to researchers, resource management agencies, and the public by use of a strong cooperative relationship with the Cooperative Extension Service and other state and federal agencies. The Institute program was developed cooperatively by higher education faculty and state and federal agencies. (USGS)
W91-11914

FISCAL YEAR 1989 PROGRAM REPORT (TENNESSEE WATER RESOURCES RESEARCH CENTER).
Tennessee Univ., Knoxville. Water Resources Research Center.
E. W. Colglazier.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-195768. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1591-01, September 1990. 30p, 1 fig, 7 ref. USGS Contract No. 14-08-0001-G1591. USGS Project No. G1591-01.

Descriptors: *Information transfer, *Research, *Tennessee, *Training, *Water resources Institutes, Education, Projects.

This report details the FY 89 research program accomplished by the Tennessee Water Resources Research Center under the U.S. Department of Interior's State Water Resources Research Institute Program. Project 02 involves the final phase of a multi-year project that focused on a major water quality problem in Tennessee--soil erosion due to agricultural practices. The investigators utilized a nonpoint sources water quality model, Hydrological Simulation Program--Fortran (HSPF), to analyze and predict the quantity and quality of runoff from the North Reelfoot Creek Watershed. The overall purpose of the project was to demonstrate the usefulness of the model as a watershed management tool that can be utilized across the State. Project 03 addresses the problem of the contamination of groundwater sources with organic chemicals from underground storage tanks, from spills and from other waste disposal practices. The results of the project will be useful in remediating hazardous waste sites and aquifers contaminated with toxic organics. The models developed will facilitate (1) evaluation of the feasibility of soil-vapor stripping, water flushing and surfactant flushing at particular sites; (2) cost and time estimates; (3) optimization of remediation facility design; and (4) design of post-cleanup monitoring. Project 04 is concerned with the development of an accurate evapotranspiration (ET) estimation method for Tennessee and the mid-south. The primary objective of the study was to simultaneously obtain precise measurement of ET and climatological parameters to be used in the development of an accurate transportable ET prediction method. Project 05 addresses a major public concern in eastern Tennessee--the protection of municipal drinking water supplies. Many Tennessee communities utilize springs emerging from carbonate rock as their source of drinking water and these sources are very vulnerable to contamination from a variety of sources. This research project utilized groundwater tracers to provide the necessary documentation of groundwater flow path and velocities which is needed to define potential sources of pollution and delineate the areas around the public water supplies that need special protection. (Gangaware-TN, WRRC)
W91-12632

FISCAL YEAR 1989 PROGRAM REPORT (ILLINOIS WATER RESOURCES CENTER).
Illinois Univ. at Urbana-Champaign. Water Resources Center.
G. E. Stout.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-192401. Price codes: A03 in paper copy, A01 in microfiche. Annual Report No. 25, 89-G-1560-01, 1990. 21p. USGS Contract No. 14-08-0001-G1560. USGS Project No. G1560-01.

Descriptors: *Illinois, *Information transfer, *Research, *Training, *Water resources Institutes, Education, Projects.

The University of Illinois Water Resources Center was established in 1963 to 'encourage and coordinate universitywide planning and implementation of interdisciplinary programs for research and graduate education in water resources.' Since designation by the State of Illinois as the 'institute' for Illinois, the center's activities have become statewide. This report describes research accomplishments, information transfer, and other research activities of the center during fiscal year 1989. Working through the center, researchers applied USGS funds to the study of water table effects on movement of agricultural chemicals to groundwater in Illinois; irrigation water use in Illinois; strategies for soil water management and groundwater conservation; roles of atmospheric H_2O_2 in transformations of organic pollutants in surface waters; numerical studies of the transport of kinetically absorbing solutes through three-dimensional heterogeneous aquifers; agricultural utilization of waste materials to reduce pesticide movement to groundwater in a sandy course-textured soil; and analysis of drainage district channel management effects on farm operations and profitability. The research activities of the center were well coordinated with those of other institutions within the state performing water research, largely through the director's involvement on numerous committees and the center's role in administering university grants for water resources research and grants for the research component of the Illinois-Indiana Sea Grant Program. In addition, the center served as the executive offices of the International Water Resources Association. (Stout-IL Water Resources Center)
W91-12633

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

BIBLIOGRAPHY ON SAMPLING GROUND WATER FOR ORGANIC COMPOUNDS.
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 5A.
W91-11861

LOCATIONS MAPS AND LIST OF U.S. GEOLOGICAL SURVEY REPORTS ON WATER RESOURCES IN ALASKA, 1950 TO 1990.
Geological Survey, Anchorage, AK. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 91-60, 1991. 44p, 16 fig. Compiled by E. F. Synder.

Descriptors: *Alaska, *Bibliographies, *Water resources, Data collections, Maps, Reports, Water resources data.

Reports written by U.S. Geological Survey members between 1950 through 1990 on the water resources of Alaska are listed. Location maps are given for six geographic areas: Arctic Slope, West, Southwest, East-Central, Southcentral, and Southeast. Numbers on the location maps refer to the bibliographic citations. Reports are also cited for the following categories: Statewide and Topical, Glaciers, and Trans-Alaska Pipeline System. (USGS)
W91-11942

10D. Specialized Information Center Services

WATER QUALITY TRAINING PROGRAM FOR THE LOUISIANA COOPERATIVE EXTENSION SERVICES.
Louisiana State Univ., Baton Rouge. Cooperative Extension Service.
B. G. Kelly, and B. Branch.
Available from National Technical Information Service, Springfield, VA 22161 as PB91-192336. Price codes: A06 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute, Baton Rouge, Project Completion Report, September 1989. 104p. USGS Project No. G1565-22.

Descriptors: *Education, *Information transfer, *Louisiana, *Training, Drinking water, Information exchange, Water quality.

The Information Transfer Program of the Louisiana Water Resources Research Institute, in conjunction with the Louisiana Cooperative Extension Service (LCES), developed a water quality training program for the state and parish staff of LCES. The purpose of the training program was to help LCES staff, through improving technical competence and availability of specialized information, more effectively and efficiently meet the citizens' requests for information and promote their understanding of water quality issues. Seven one-day workshops were planned. To date, four workshops have been conducted at LCES district offices in Alexandria, Shreveport, Tallulah, and Baton Rouge (two districts combined meetings here). Other workshops are scheduled for fall, 1989. The workshops focused on drinking water issues, and included topics as natural ingredients to water quality, water quality standards, health effects of water quality, man's insults to water quality, home treatment devices, and area agency responsibilities over water quality. Presenters were experts from universities, and state and federal governmental offices in-state. Presently 220 LCES staff members have participated in the workshops. Future plans include development of the workshop materials into a water quality reference manual, conductance of additional workshop, and development and implementation of additional materials and programs on other water quality issues. (Kelly-LA State U)
W91-12642

10F. Preparation Of Reviews

CHEMICAL REACTIONS OF METALS WITH HUMIC MATERIAL.
Institute of Terrestrial Ecology, Grange-over-Sands (England). Merlewood Research Station.
For primary bibliographic entry see Field 2K.
W91-12808

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4 WATER QUANTITY MANAGEMENT AND CONTROL

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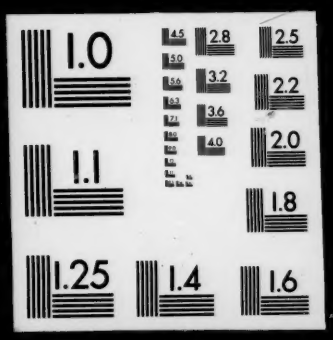

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